Telecommunications Study and Municipal Network Business Plan for

City of Kirkland

Kirkland, Washington

Supplemental Report

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Return to Table of Contents

CITY OF KIRKLAND

Telecommunications Study and Municipal Network Business Plan

TABLE OF CONTENTS

Return to Table of Contents

CITY OF KIRKLAND

Telecommunications Study and Municipal Network Business Plan

TABLE OF CONTENTS (cont.)

EXHIBITS (On Compact Disk)

APPENDICES

Return to Table of Contents

CITY OF KIRKLAND

Telecommunications Study and Municipal Network Business Plan

1. Summary

This supplemental report to the Telecommunications Study and Municipal Network Business Plan provides supporting information for the recommendations and business plan analysis provided in the main plan document. The Supplemental Report is divided into five sections:

- *Technology Trends:* Current and emerging connectivity technologies, convergence of technologies, and a review of wireless technologies used in the conceptual design.
- *Competitive Assessment:* A compilation of incumbent providers and insights on the forces that shape the competitive framework.
- *Market Assessment:* Results and analysis of Internet, phone and written surveys and feedback from in-depth interviews.
- *Regulatory Assessment:* Information and analysis on current and expected legislative and regulatory changes in the telecommunications industry, including both federal and state levels.
- *Industry Trends:* Convergence, the relationship between connectivity services and economic development, what it takes to be considered a wired city, and best practices for municipalities.

2. Technology Trends

2.1 Connecting Products and Services

The City of Kirkland could consider a variety of services for its business and residential markets, including—

- Specialty data transport services for medical, educational and business ventures,
- Home and business security monitoring,
- Dark fiber interconnectivity, and
- Other opportunities that optimize the connectivity infrastructure in Bellevue and Kirkland.

Offering telecommunication or connectivity services is not like supplying water and wastewater services. Businesses and residents have a choice among providers and a range of options. As in any business, one of the keys to long-term success is the city's ability to modify existing products and create new services to attract and retain customers. This is true regardless of the services chosen.

As a municipality, therefore, finding the "gaps" in service is important. Such gaps include services that are unavailable, do not meet consumer needs, or are driven by economic development or other benefits.

2.2 Convergence of Technologies

User Groups

In this section, we will examine the connectivity needs of four user groups—municipal government, key businesses, small and retail business, and residential services.

Municipal Government

Government organizations at the municipal and county levels are seeing increased need for all types of bandwidth for the future and adopting new ways of communicating within and among government units and to the general public in order to meet the needs of the extended user community. New applications and communications technology allow government to be more responsive and productive. New technologies, such as Internet Protocol (IP)-based telephony and video, can be used to decrease costs while increasing functionality and security.

A growing issue within public safety and public works groups is the need for mobile networks that allow high-speed access to city and county databases. Public safety organizations are using these links to allow employees to submit reports, send and receive e-mail, and access database information from the field. Public works agencies can perform many of the same functions as well as access GIS data to determine the location of facilities to support construction or repair activities. They can often use this same communications system to read utility service meters and monitor utility systems through IP-enabled Supervisory Control and Data Acquisition (SCADA) systems.

Key Businesses

Large businesses frequently locate near communications facilities that have been developed to serve the needs of government. Recognizing that construction costs level out as additional infrastructure is added, government can work with the private sector to share the cost of linking facilities. Government and large businesses share many of the same needs, including linking nearby facilities to support voice, video and data services at high-speed.

Large businesses have unique needs that may influence communication within the community. For example, the work-at-home trend drives the need for high-speed services[1] to residences. Employees need telephone access, a computer and high-speed, always-on networking to meet the needs of the current business model. Work-at-home is a growing trend as employees balance the needs of their professional life with the time they dedicate to family and outside interests. Benefits for businesses include a reduction in overhead expenses because of the smaller facility requirements when more employees work offsite.

Traveling employees also need to be able to communicate from remote sites. Areas of the city and county that support the lodging industry need to provide traveling professionals with access to high-speed Internet to give travelers access to e-mail and business information. The lodging industry is recognizing this need as travelers increasingly consider the availability of Internet access when choosing lodging.

Small and Retail Businesses

Small businesses and retail enterprises continue to grow as a user community on the Internet. Small businesses provide a direct channel to consumers for the products manufactured by large industries. Small businesses must have access to the Internet to place parts orders, enter warranty information, order materials, and provide financing for purchases—functions that can no longer be performed by fax or hard copy. Small enterprises also depend on e-mail and Web-based access to larger businesses that provide the manufacturing and logistics functions[2] needed to support modern small business environments.

The level of Internet usage by Kirkland businesses is similar to the national average. High-speed Internet usage, however, is over 10 to 15 times that of the national average. In Kirkland, approximately 81 percent of businesses have Internet access. Of these, only 5 percent use dial-up services. Of the remaining businesses that do not have access, 20 percent plan to gain access in the next year.

Increased need to control costs leads to increased reliance on company-oriented network services. Businesses with two or more local facilities install T-1, wireless and fiber optic links between facilities for voice, data and video services that are necessary to support the enterprise. Often, the cost of the link is more than offset by improved service levels and less duplication of labor, equipment and software.

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[1] "Understanding Broadband Demand, A Review of Critical Issues." U.S. Department of Commerce, Office of Technology Policy. September 23, 2002. This document is available at: www.ta.doc.gov/reports/TechPolicy/Broadband_020921.pdf

[2] "Understanding Broadband Demand, A Review of Critical Issues." U.S. Department of Commerce, Office of Technology Policy. September 23, 2002. This document is available at: www.ta.doc.gov/reports/TechPolicy/Broadband_020921.pdf

Residential Services

Residential users typically fall into one of two groups. One group demands a wide range of services including high-performance Internet access, large numbers of focused entertainment channels and one or more telephones. The other group does not purchase any services beyond basic telephone. The next generation of users is likely to fall somewhere between these two extremes. Younger consumers have cellular telephones, no landline telephones, are Internet-literate and watch only select entertainment that is often time-shifted using a personal video recorder.

Residential services present a business opportunity for those organizations that are able to follow user demand. Municipal organizations are seeing opportunities to provide high-speed broadband services, which are often perceived to be a logical extension of current services. For municipals with electric utilities, a broadband network can leverage existing infrastructure, such as poles and billing systems.

Levels of residential Internet and high-speed access are considerably higher in Kirkland than nationally. Ninety-two (92) percent of Kirkland households have Internet, of which 65 percent use a high-speed option (59 percent of all households with high-speed). The national average for homes with high-speed service is only 20 percent.

Technology Models

Communications technology models vary by geographic scale and the services that are supported. Technologies that provide support for the first-mile[3] link may not be appropriate systems for a regional network. Here, we cover four network models:

1. Regional
2. Metropolitan Area
3. First Mile
4. Mobile

Regional Networks

Regional networks transport a wide variety of traffic types within a specific geographic area. The traffic may be voice, data, and various forms of video for transport or distribution. Two common examples include moving aggregated voice traffic between telephone central offices and moving video entertainment traffic from a satellite receiving station to distribution points in local cities. Large businesses or organizations might also have more creative uses, including data center redundancy, links between hospitals to support telemedicine, and links between universities to support distance learning and research efforts.

The most common transport supporting these types of links is based on Synchronous Optical Network (SONET) technology. Developed by the telephone companies to transport a wide range of voice and data traffic, SONET links cities in the U.S. and the continents of the world. As Ethernet-based alternatives continue to evolve, however, the use of SONET is on the decline. On a smaller regional scale, other technologies may be more cost effective. The declining cost of fiber optic cable and new technologies such as Dense Wavelength Division Multiplexing (DWDM) and high-speed Ethernet are opening up a range of opportunities for cities and counties.

[3] A portion of the network that connects to the end user (home or business).

Large organizations, such as government, large businesses, educational institutions and hospitals, see great value in the use of dark fiber.[4] Access to raw fiber between locations provides nearly unlimited bandwidth. Increasingly, these organizations are working together to build fiber optic infrastructure between their locations using a cooperative approach. One 10-year-old example is the CANARIE[5] network that links business, education and government organizations throughout Canada and select locations in the U.S. Each organization has partial ownership of the fiber system, a condominium approach that provides dark fiber between locations. Other organizations have established similar models that provide dark fiber to the public on a wholesale or open-access basis.

A current model for a regional network is the Los Angeles Optical Network:[6] 300 miles of fiber offered to the public on a wholesale basis. Various technologies are used to support their customers including SONET, DWDM, fiber-based Ethernet with link speeds up to one gigabit, and dark fiber to customers that want to manage their own network.

Metropolitan Area Network

The Metropolitan Area Network, or MAN, is a smaller, community-oriented version of a regional network. These networks aggregate the demand from government, education and business to build a network that links key locations in the city. The networks have a variety of characteristics that meet the needs of the local organizations. Each participant has a business goal that makes participation in the network an economic benefit. Common reasons to create a MAN include increased need for bandwidth, telephone bypass between buildings, decreased long-term costs and increased security.

The technologies used in the core of these networks are similar to those used in a regional network, including fiber optic–based technologies such as SONET, DWDM and Gigabit Ethernet. At the edges of network connectivity, using wireless and various types of copper and fiber-based links is more tactical. Access to the edge of the network is based on the individual goals of the user community.

One example of a MAN is the proposed Chicago CivicNet[7] project, which is based on aggregated demand for voice and data services by the city, schools and colleges, housing authority and transportation agencies that serve the residents of the city.

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[4] Dark Fiber: Fiber strands that are sold or leased without the accompanying transmission service. Customers are required to put their own electronics and signals on the fiber.

[5] See the Canarie Website for details on the organization at www.canarie.ca. CANARIE is Canada's advanced Internet development organization.

[6] Los Angeles Optical Network (LAON). See the LAON Website at www.ladwp.com/programs/fiber/index.htm

[7] Chicago CivicNet. Further information on this program can be found at the CivicNet Website www.chicagocivicnet.org.

First-Mile Technologies

First-mile technologies link a business or home owner to a nearby point of concentration, or hub. The nature of the link depends on population density, historical demand profiles and range of commercial service providers. The most common link is based on unshielded twisted pair cable (UTP) that has been installed by the telephone company. Coaxial cable that supports cable television is also common in many residential areas near cities. First-mile media is experiencing an evolution with new products and services available on existing UTP and coaxial systems and new ways for customers to use fiber optics and wireless technologies.

- **Unshielded twisted pair (UTP):** New technologies are extending existing UTP and coaxial cable plants. Organizations have used UTP for the last 75 years to support voice communications and some low-speed data links. The creation of Digital Subscriber Line (xDSL) technologies allows voice conversation to share the UTP link with a high-speed, always-on data link. Hybrid Fiber Coaxial (HFC) systems have similarly impacted cable television providers—addition of fiber optics to cable plants has reduced complexity, increased bandwidth and increased system reliability. Use of an HFC system, cable modem and cable-based telephone technologies expand services beyond entertainment for cable companies.

- **Fiber and UTP hybrids:** In areas with existing copper-based connectivity, some organizations use a Fiber-to-the-curb (FTTC) approach with modifications to existing systems to develop a hybrid cable plant that incorporates fiber. Typically fiber is run from the central office to the transition point, or local hub point, where the cabling system begins to diverge to serve individual customers. Active technologies are placed at the local hub to provide voice and broadband services over the shorter segment of UTP that runs to each user location. This is similar to an HFC approach in a cable television cable plant. The fiber eliminates long runs of UTP, improving signal quality and network reliability. Fiber installation is often coupled with an increase in local bandwidth to provide the additional capacity to support services such as telephone and high-speed Internet.

- **Fiber-to-the-premises (FTTP):** Newer all-fiber optic-based systems are expanding the capabilities of systems in the first mile. New construction in greenfield[8] areas is the first to see fiber optic technology in the first-mile connection. Both FTTC and FTTP incorporate fiber optics to bring high-bandwidth capability into the first-mile connection. FTTC eliminates the need for large bundles of UTP running to the central office. The UTP in the link is relatively short and makes it possible to support multiple services such as telephone, Internet and video on demand. FTTP goes a step further by taking fiber directly into homes.

[8] No existing infrastructure.

FTTP provides multiple fibers to premises capable of supporting a full range of current services (such as cable television, telephone and Internet), along with capacity for new services that will be created in the future. The key to a fully fiber optic system is cost. FTTP will slowly be adopted until the cost of a cable plant installation is equal to the cost of building an FTTC or HFC-based system. Another factor to consider is the total cost of ownership. "The cost of maintaining an FTTP network is far less—perhaps as much as four to eight times—than the maintenance costs for HFC,"[9] according to an initial study by Wave7 Optics, a vendor of FTTP systems.

Many of the FTTP systems that have been installed are in new areas of a city where copper cable was not present. With the proper mix of businesses, multi-dwelling units and residential properties, the per-drop cost of a FTTP system approaches that of other competitive technologies. The long life and high bandwidth of the fiber optic–based system tips the decision in favor of this technology.

- **Wireless:** Emerging technologies also include wireless systems. Two systems being used for wireless links include those based on the IEEE standard 802.11, also called WiFi, and the emerging IEEE standard 802.16, also called WiMax. WiFi-based systems provide high-speed links over distances of about 300 feet as an alternative to cabling in homes and businesses. Emerging WiMax systems are oriented more toward last-mile connections between an access point on a high-speed network and the surrounding user community within a five-mile radius. With changes to antennas, the WiFi systems provide longer links between buildings or last-mile links in a small communities, though they have not been optimized to effectively support these types of environments. These two wireless approaches can be used together, with WiMax providing the last-mile link and a WiFi system providing low-cost local access. Not uncommonly, businesses use WiFi units to create local "hotspots," or locations where the public can obtain wireless access to the Internet. Hotspots are commonly found at airports, restaurants, hotels, public spaces and similar locations that are accessible to the public. Table 2-1 presents a comparison of these technologies.

Table 2-1: Wireless Technology Characteristics

Technology	Distance	Data Rate (Throughput)	Interference
Ultra-wideband (emerging)	30 feet	480 Mbps	Walls
802.11 WiFi	300 feet	4 to 10 Mbps	Trees and buildings
802.16 WiMax (emerging)	30,000+ feet	60 users @ 1.5 Mbps	Trees and structures
Proprietary	10,000–25,000 feet	3 Mbps to 24 Mbps	Trees and structures

[9] See http://www.cedmagazine.com/ced/2004/0304/03a.htm.

A number of manufacturers that provide last-mile support offer proprietary wireless systems (those not based on IEEE standards). In many cases, IEEE standards evolve from the technologies these manufacturers develop. Current systems can support the last-mile link, providing a variety of ranges, interfaces, modulation schemes and speeds. None of the systems, however, will interoperate with other manufacturers' equipment. These proprietary systems can be expected to move toward standards compliance as standards are approved and adopted. Because proprietary systems will be replaced by standards-compliant equipment in future, they should not be considered to be long-term solutions.

Emerging ultra-wideband wireless approaches promise the ability to deliver high bandwidth by using smart, low-power radios. The ultra-wideband approach—approved by the FCC as demonstration technology—will use frequencies that are licensed for other uses but are not being used during a particular time or at a particular location. As this approach becomes practical, another evolution in wireless technology may take place.

- **Demand for broadband in the last mile:** Products and services that may influence the nature of the first-mile link include increasing demands for high-speed Internet, declines in the demand for landline-based telephones, the trend toward increasingly focused entertainment, and a more technically savvy and selective consumer. It is predicted that the younger generation of consumers who are Internet-savvy will not be satisfied with dial-up Internet access. This emerging consumer group may drive up the demand for broadband-based access and is changing the demand for other types of services.

  - The cellular telephone, along with broadband Internet access and technologies such as IP telephony, is decreasing the demand for landline-based telephone service. Students and single adults increasingly depend on the cellular telephone as their primary means of communication.

  - Many younger adults spend increasing amounts of time on personal computers (PCs) for entertainment focused on programming of interest. The increasing popularity of personal video recorders (PVRs) allows entertainment to be time shifted. Sony has started providing download content over satellite-based services that might lead to other types of entertainment downloaded to PVRs in the future[10].

With the above consumer trends, the applicability of wireless first-mile links will continue to increase.

[10] "Pressplay Goes Unlimited, Rhapsody Does DirecTV." For the complete article, see www.Internetnews.com/bus-news/print.php/1437451.

Mobile Communications

Mobile communications are supported in two areas: (1) private systems that cities and counties build to support police and fire and (2) cellular telephone-based systems that support the general public. The needs of these two groups, however, are significantly different.

- **Municipal organizations** need mobile support within a defined geographic area. These systems are predominately text-based and use specialized equipment that communicates on licensed frequencies. Government's need to access diverse forms of data is increasing to meet the needs of a growing user population. The growth of Geographic Information Systems (GIS) with Web-based interfaces is also expanding the user population. For example, public safety agencies use a GIS to note the existence of hazardous chemicals, and public works agencies use maps of water, sewer, and lighting systems. Public employees who use laptops also need access to this data. New wireless systems running in the 900 MHz[11] band have been designed to provide high speeds (about 1 Mbps[12]) that support access in a moving vehicle with minimal interference from foliage and buildings.

- **The general public** has different needs, which they access through cellular telephone providers that incorporate features such as text messaging, e-mail and Internet access into the new generations of cellular telephones. These features, along with nationwide service, make the cellular telephone a key tool of business users. The five major cellular telephone companies are building new and faster networks that incorporate higher speed data services. Higher speed service through a cellular telephone delivers about 30–75 Kbps, and some providers claim even faster speeds. Cellular telephone technology is now being combined with Personal Data Assistants (PDAs) such as the Palm Pilot; this combination technology is likely to be one source for collecting and distributing business-related data in the future.

2.3 Technology Trends

The latest developments in connectivity technologies have radically altered the Wide Area Network environment with the addition of multiple types of technology at a wide variety of price points. Only ten years ago, T-1 and dial-up links were the only ubiquitous methods of connectivity for business and home user communities. This section provides a brief overview of the variety of connectivity technologies now available to connect individuals to the world. A more detailed presentation on connectivity technologies is included in Exhibit II.

Telephone Links

Connectivity technology offered by the telephone company has moved from high-priced, leased T-1 links to more affordable xDSL links. Telephone companies have reduced pricing on most services and increased the mix of services offered. For example, a T-1 line that recently cost over $1,000 might now cost as little as $100 when purchased in quantity. xDSL-based links can now share a line with voice traffic or, in dedicated mode, provide data throughput exceeding that of a T-1 line.

[11] MHz: Megahertz, one million cycles per second.
[12] Mbps: Megabits-per-second, one million bits per second.

To support DSL users, telephone companies are adding fiber optics into distribution networks to reduce the length of copper cable between a central office and its satellite premises. As the length of the copper link is reduced toward 4,000 feet, the speed of DSL links can be increased, approaching 20 Mbps. Fiber optic infrastructure upgrades also improve the reliability of the network so that companies can offer additional services to their customers.

On the downside, telephone companies must cope with a changed competitive landscape. A range of providers and technologies threaten to reduce the dominance of telephone companies in voice and data services. Cable, wireless and satellite companies are attempting to provide products at price points that compete directly with telephone companies' voice and data services. These market-based pressures reduce the ability of telephone companies to improve their network as described above. Although telephone companies continue to maintain their leadership in the business community, many home users are severing their link with the telephone company in favor of the cable company and cellular telephone providers. This early decline in the number of lines leased has made some telephone providers reluctant to invest in fiber optic infrastructure upgrades.

Cable Television

Cable television companies have implemented the newest connectivity technology to make great improvements in their systems. Over the past five years a large percentage of cable companies have added fiber optic technology, increasing reliability, increasing bandwidth and expanding services offered. Modern cable companies now provide more than 70 analog channels of video, hundreds of digital video channels, DVD-quality music, video on demand, voice telephone and high-speed Internet access.

As a result of upgrades to cable company infrastructure and increases in the mix of services, residential users now consider cable modems and the services of local cable companies to be the high-performance connectivity solution of choice. High-speed Internet access and telephone service from the cable company are now becoming common in addition to traditional video-oriented services. This is likely to continue as consumers begin to adopt new voice over IP (VoIP) services offered by Internet and cellular-based providers.

Cable television companies, however, have serious customer service and image perception issues. Most consumers see cable television providers as high priced for the value delivered.

Satellite Companies

High-speed Internet service is available from satellite companies, such as DirecTV and Starband, at speeds similar to xDSL links (although pricing is slightly higher). These services are a reasonable alternative for rural users who cannot obtain service from any other vendor. With a nationwide footprint for services, satellite-based connectivity technology has a substantial potential market. Upfront equipment costs, latency induced by distance to the satellite, and little meaningful marketing activity, however, make high-speed satellite-based connectivity a slow-growth technology. Satellite providers are therefore also going through a period of consolidation.

Electric Utilities and Broadband Power Line

Electric utilities are an emerging provider of high-speed connectivity services using broadband power line (BPL) technologies. The substantial existing infrastructure of electric utilities coupled with BPL technologies provides the potential to supply a wide range of connectivity services and makes a very attractive business case for the electric utilities. Combined revenues from providing webcam security, high-speed Internet, automated meter reading, demand management and other services may help justify installation of the necessary infrastructure upgrades for BPL.

BPL technology is still in the pilot stage, however, with unresolved questions about interference. A high frequency signal in the range of 2–30 Mhz is transmitted through an unshielded cable, which can result in significant radio interference. The debate is not whether noise or interference is created but how far away from the BPL device interference will be seen and whether it will leave an RF band or channel inoperable. The Federal Communications Commission (FCC) has responded by proposing rules that would require a BPL operator to cease operation or modify its equipment if it were found to interfere with another user.

Wireless Systems

Wireless systems have become a very popular form of connectivity technology. Fixed wireless, Local Area Network (LAN)–based wireless used in the external environment, and mobile wireless (mainly cellular telephone–oriented systems) will continue to revolutionize the way businesses and their customers communicate.

Fixed wireless systems continue to expand at a rapid pace, and prices have dropped on the most common 802.11 WiFi systems to the extent that an access point costs under $40 and an interface card costs $20. We anticipate similar price performance trends for equipment that uses newer fixed wireless standards to provide increased speeds, increased distances and additional functionality (such as equipment supporting the proposed 802.16 WiMax standard). The early LAN-based wireless systems used by many can be expected to adopt the newer standards-based approach that is optimized for the external environment.

Ultra-wideband technology has entered the design phase, making it possible to support high-bandwidth applications over short distances—such as within the home—without interfering with existing wireless applications. Very low power levels and the sensing of “available” and “busy” frequencies allows for a large dynamic bandwidth able to support very high data rates.

Cellular telephone providers are beginning to implement connectivity technology, allowing for data transfer at higher speeds. The five largest vendors are implementing mobile, data-oriented networks that will provide Internet connectivity comparable to the fastest current dial-up connections (at throughput rates of about 50–100 Kbps). At least one vendor has begun implementing a service that offers throughput in the range of 300–400 Kbps. This will be followed by equipment supporting the proposed 802.20 standard for mobile communications. End user equipment can be expected to support multiple fixed and mobile approaches to connectivity, providing the greatest speed based on the services it senses at a particular location.

Emerging Technologies

A range of hybrid technologies in the early stages of development will provide more bandwidth for both fixed and mobile environments and will provide greater bandwidth to many users. Fiber-to-the-premises (FTTP) and new types of wireless connectivity technology may lead to significant changes in the way we communicate. More importantly, the various types of technology are converging toward one ubiquitous, interconnected fabric of seamless communications.

Fiber-to-the-Premises

For permanent links, the cost of fiber optic components and related hardware has decreased to a point where fiber optic connectivity is only marginally more expensive than other technologies for new installations. Some models show that the increased installation cost of an FTTP system is offset by significant maintenance savings when compared to other forms of last-mile connectivity. Increased use of high-capacity fiber-based connectivity technology may make possible the provision of telephone, high-speed Internet, video programming and other services over one fiber link using only two or three fibers to a given location.

Ultra-wideband

Wireless technology is making great advances in its ability to carry more content with less interference. New ultra-wideband technology provides LAN-like bandwidth over short ranges. When combined with FTTP, this increase in short-range bandwidth can provide broadband connectivity throughout the home without the need to install expensive wires in the walls.

Hybrid Connectivity

Another technological advance is emerging in the form of “smart” connectivity that can detect and utilize the technology available at various locations. Imagine plugging your laptop into an existing wired network in your office and enjoying a Gigabit Ethernet link. In your car, use the high capacity connection through your cellular telephone adapter. In rural areas outside the range of cellular telephones, use a mobile antenna to connect to a satellite-based high-speed link. At the airport, access the Internet and e-mail using wireless Hotspot at hard-wired speeds. Currently, standards groups in the U.S. and Europe are actively discussing ways to standardize connectivity across technology types and across multiple locations. Necessary adaptations are likely to take place at the device level rather than the network level.

2.4 Evaluating Wireless Technologies and Offerings

In evaluating the technology solutions for the City of Kirkland, we have identified both the criteria and the technology that most closely meets the city’s wireless connectivity needs. This section will discuss the wireless technologies and offerings that were reviewed during the planning of the proposed networks.

In this section we will discuss the process used to identify the appropriate technologies as well as identify the technologies considered. We will discuss the overall connectivity architecture, identify the manner in which various connectivity technologies will interrelate and discuss how emerging wireless technology standards are likely to present implementation choices in the foreseeable future. Finally, as we are recommending a significant role for wireless technology, we will discuss in some detail Wi-Fi and WiMax wireless solutions.

In order to meet the connectivity goals of the City of Kirkland we have reviewed the existing fiber optic network infrastructure and evaluated compatible wireless connectivity solutions. The fiber optic system will provide high bandwidth to selected wireless interface locations within the city. Our examination of wireless technology has included Wi-Fi (based on the 802.11 standards family and currently the most common solution for homes and businesses); WiMax (based on the 802.16 standards family and currently in an early introductory phase); cellular mobile wireless; wireless hybrid solutions; and proprietary wireless solutions.

For each technology we considered the following:

1. Will the solution support broadband data rates?
2. Can it be integrated into an overall system architecture?
3. Will it be reliable?
4. Will it provide the coverage required?
5. Can it be deployed with an appropriate level of security?
6. Are there management tool available to minimize operational and deployment costs?

Each of these criteria was applied to different wireless technologies to determine the most appropriate technology choices. Our analysis shows that a two level wireless system is most appropriate for Kirkland. The first level provides the longer links between the fiber optic network and the hot spot or zone. The second level provides the local distribution within the hot spot or zone.

Approach For Evaluating Wireless Technology

Wireless systems in a community can provide connectivity where other types of technology such as fiber optics may not be appropriate or cost effective. A hybrid approach is becoming popular where wireless systems support the end user while fiber optic systems form the core of the network. Our evaluation focused on wireless systems that are optimized to support backbone links over larger areas (‘first level’ with coverage distances in miles), and wireless systems that provide local client access (‘second level’ with coverage distances in hundreds of feet). We note that the evaluation criteria for a particular wireless system may or may not be optimum when the specific application and physical characteristics of the local environment are considered. Equipment that meets the needs of one environment may not be optimum for another environment.

For this evaluation seven vendors products were reviewed according to the six criteria indicated above. Two products provided proprietary WiMax-based solutions for coverage over large geographic areas and are appropriate for ‘first level’ use. These products are the Motorola Canopy and the Alvarion BreezeACCESS VL. The other five products support Wi-Fi standards-based meshed network solutions for connectivity to end user devices at the ‘second level’. These vendors are BelAir Networks, Mesh Networks, Tropos Networks, VIVATO, and Ultamesh.

We well understand that technology is changing rapidly. In order to develop a specific plan with real cost figures it was necessary to select real offerings from today’s wireless vendors. While both the vendors in the market and the technology offered will undoubtedly change over time, we feel that the relationship between area covered and cost of coverage will remain relatively constant or quite possibly decline. This means that even if our selected technology is superceded or our designated vendors disappear, the wireless cost figures in our plan will still be of use. The figures will remain usable so long as the area to be covered does not significantly change.

Evaluation of 'First Level' Wireless Technologies

Current level one wireless equipment uses proprietary approaches to connectivity. For example, antenna sizes, modulation schemes, link speeds and cabling approaches vary greatly between various vendors' offerings. These differences are beginning to converge toward the approaches being defined by the 802.16 (WiMax) committees. Market forces are going to dictate similarities between devices that will allow interoperability between vendors equipment. Until the 802.16 products begin to emerge in the market place in the coming year, proprietary equipment is required to meet first level communications needs.

Alvarion[13]

The BreezeACCESS VL is a modular access point that operates in the 2.4 and 5.8 GHz unlicensed bands. Each sector antenna covers a 120 degree arc and provides 24 Mbps of bandwidth assuming the unit is fed by a 100 Mbps Ethernet connection. The product uses a modulation technical that provides some near line of sight capability. Given clear line of sight, this product may be expected to provide support for clients as far as two to three miles.

A small subscriber module and antenna is located at each receiving location to provide access to the network. Two client modules are available, one that provides six megabits of bandwidth and another that support twenty-four megabits of bandwidth.

The disadvantage of this product is the need for line of sight between the access point and the client to realize the full capacity of the system. An evaluation of the Alvarion offering is presented in Table 2-2.

Table 2-2: Alvarion Evaluation

Category	Evaluation
Will the solution support broadband data rates?	Yes
Can it be integrated into an overall system architecture?	Yes
Will it be reliable?	Yes
Will it provide the coverage required?	Yes
Can it be deployed with an appropriate level of security?	Yes
Are there management tool available to minimize operational and deployment costs?	Yes

[13] Information about the Alvarion products may be found at www.alvarion.com.

Motorola[14]

The Motorola Canopy system is composed of three components: the access point, the client access module and a backhaul system that has the same form factor as the client with a dish added behind each antenna. Each segment of the access point supports ten megabits of bandwidth over a sixty-degree arc with the full six segments providing an aggregate bandwidth of approximately sixty megabits. The transmit and receive cycles for the access point are timed using a Global Positioning System (GPS) link. This means that Canopy nodes may be placed closer together without any interference between adjacent access points. When installed using the pre-made cables and mounting components from Motorola the installation of the client is plug and play.

A small client antenna is placed at each receiving location to provide access to the local PC over a Ethernet link. Power for the client unit is carried on the same cable as data in a Power Over Ethernet (POE) type of approach. When installed using the pre-made cables and mounting components from Motorola the installation of the client is plug and play.

The original design of this unit was to provide always-on connectivity supporting a Wireless ISP application. The design supports all the features needed to support this application including remote code upgrades, status monitoring, bandwidth metering, Transmission Control Panel (TCP) port restrictions, etc.

One disadvantage of the Canopy family is that the product may interfere with any 802.11a-based equipment that is attempting to operate in the same area. As Canopy operates in the 5 GHz frequency range it is strictly a line of sight system and the range of the system deteriorates quickly when foliage is encountered. This can work to an advantage when the Canopy is used above the tree line and the home 802.11a wireless is at ground level. In this situation the foliage may serve to isolate the Canopy environment from the 802.11a environment, greatly reducing the likelihood of interference. An evaluation of the Motorola offering is provided in Table 2-3.

Table 2-3: Motorola Evaluation

Category	Evaluation
Will the solution support broadband data rates?	Yes
Can it be integrated into an overall system architecture?	Yes
Will it be reliable?	Yes
Will it provide the coverage required?	Yes
Can it be deployed with an appropriate level of security?	Yes
Are there management tool available to minimize operational and deployment costs?	Yes

[14] Information about the Motorola Canopy products may be found at www.motorola.com/canopy.

Evaluation of 'Second Level' Wireless Technologies

Five vendor's products were evaluated as possible solutions for connectivity to the end point devices. This section describes each of the five product sets that were evaluated. All of these devices use 802.11 (Wi-Fi) standards. It is important to note that while many of the currently shipping models provide support for the 802.11b standards, in almost every case support for the higher speed 802.11g standard has been announced and in several cases devices are available that support 802.11a/b/g standards.

BelAir Networks[15]

BelAir Networks supports a mesh network system architecture using a platform that contains two radio systems. A standards-based 802.11a radio functions as the backhaul link and an 802.11b radio provides end point access.

The strength of the BelAir approach is providing ubiquitous coverage in a defined area using one product designed for the exterior environment. As an example, the main radio can be placed on a tall building and surrounded by radios that provide access to the main node as well as offering local client access. This product is especially appropriate when the main node has access to a high-speed network link that can support the access requirements for all the clients in the surrounding area. This product could also support in-building access using an outside-in approach with the access nodes placed around the outside of the building providing access through the structure.

A possible disadvantage of the BelAir approach in Kirkland is the distance limitation and possible latency characteristic of the 802.11a-based backhaul radio. These radios typically support distances in thousands of feet, rather than miles, unless an external antenna system is used. Overall, the BelAir approach has the capability of supporting client hot spots where line of sight for the backhaul radio can be established. An evaluation of the BelAir Networks offering is provided in Table 2-4.

Table 2-4: BelAir Network Evaluation

Category	Evaluation
Will the solution support broadband data rates?	Yes
Can it be integrated into an overall system architecture?	Questionable
Will it be reliable?	Yes
Will it provide the coverage required?	Backhaul No
Can it be deployed with an appropriate level of security?	Yes
Are there management tool available to minimize operational and deployment costs?	Yes

[15] Information about BelAir Networks and related products and services can be found at www.belairnetworks.com.

MeshNetworks[16]

MeshNetworks provides hardware and software that supports networks based upon the mesh architecture. The MeshNetworks product line is composed of four primary products including a card for a laptop cardbus slot, a repeater, an access point and control software.

The MeshNetworks product concept is that every device is capable of forming an adhoc peer-to-peer network connection. Each computer acts as both an end node and a repeater. Should the user be separated from the access point with the link to the Internet it may be possible to relay through other computers to establish the link. The graphic on the right shows the form factor for the access point and repeater modules.

Additional devices are available including vehicle mounted equipment and portable equipment needed to establish networks. There is a software only package that can create a mesh network using generic 802.11 hardware. The software only approach will need to use the processing power of the local client compared to the proprietary MeshNetworks card that has the software resident in the wireless module. Management of this network is through a graphical-based management program.

The MeshNetworks concept depends on using the computing power in each end point device to manage the interactions of the mesh. Also the MeshNetworks solution, while based on 802.11 protocols, uses proprietary protocols that only allow connections with other MeshNetworks devices. The power of this equipment is seen where an organization wants to develop a closed mobile network over a defined coverage area.

The MeshNetworks solution is not appropriate where a public Hot Zone environment is desired using standards-based hardware and protocols easily available to all potential users. An evaluation of MeshNetworks is provided in Table 2-5.

Table 2-5: MeshNetworks Evaluation

Category	Evaluation
Will the solution support broadband data rates?	Yes
Can it be integrated into an overall system architecture?	No
Will it be reliable?	Yes
Will it provide the coverage required?	No
Can it be deployed with an appropriate level of security?	Yes
Are there management tool available to minimize operational and deployment costs?	Yes

[16] Information about MeshNetworks products and services can be found at www.meshnetworks.com.

Tropos Networks[17]

Tropos Networks provides wireless access points supporting mesh architectures. The access points are based upon the 802.11b standard allowing the client to use off the shelf Network Interface Cards (NIC) cards or the wireless device that comes built in to many of the newer laptops. Two hardware platforms are available, the 3110 indoor Wi-Fi cell and the 5110 outdoor Wi-Fi cell.

The 3110 unit is optimized for indoor use with a transmit power of 100 milliwatts. This unit is targeted toward providing wireless support indoors to areas within large structures such as shopping malls.

The 5110 unit is optimized for installation in the outdoor environment. It has a transmit power of 1000 milliwatts and a broad range of powering options including Power over Ethernet (POE) and power through a street light photocell.

Tropos networks have a network management package that enables management of the access points using a graphic user interface.

The main disadvantage to the unit is the requirement to attach the wireless device acting as the main gateway to a high speed link via either a fiber optic connection or via another vendors high speed wireless system to connect back to a backbone fiber optic node. An evaluation of the Tropos offering is shown in Table 2-6.

Table 2-6: Tropos Network Evaluation

Category	Evaluation
Will the solution support broadband data rates?	Yes
Can it be integrated into an overall system architecture?	Yes
Will it be reliable?	Yes
Will it provide the coverage required?	Yes
Can it be deployed with an appropriate level of security?	Yes
Are there management tool available to minimize operational and deployment costs?	Yes

Vivato[18]

Vivato provides 802.11-based wireless networks with “smart” antennas that use phased array technology. On a packet-by-packet basis the antenna will focus on each active user to concentrate radio energy. This concentration improves the operability of the Wi-Fi system providing enhanced coverage and range for the product. For omni directional support the Vivato system requires four access points, as the antennas are directional with a one hundred degree field.

[17] Information about Vivato products and services can be found at www.vivato.net.

[18] Information about Tropos Networks and related products and services can be found at www.tropos.com.

The base product is enhanced with an access point/bridge that can extend the range of coverage by providing a repeater type of function. The use of this repeater approach allows the Vivato system to go around corners providing access to those users that may not have sight of the main access point. The current product set supports 802.11b and 802.11g standards. Products are available for operation in both indoor and outdoor environments.

Vivato provides a good approach for extending the reach of 802.11 technology. Although not a true mesh architecture, the Vivato approach provides a significant improvement on the range of the basic 802.11 wireless network. This approach can be used to support hot spots and larger buildings with a smaller number of access points. Use of the repeater approach will augment the wireless system so that cabling is not required for all access points.

The repeater approach has some disadvantages where true mesh architecture is desirable. The ability of the mesh radios to dynamically adapt to interferences and identify the path with the greatest bandwidth available can be very powerful in the external environment. The static repeater approach seems best suited in the controlled internal environment. An evaluation of the Vivato offering is shown in Table 2-7.

Table 2-7: Vivato Evaluation

Category	Evaluation
Will the solution support broadband data rates?	Yes
Can it be integrated into an overall system architecture?	Limited
Will it be reliable?	Yes
Will it provide the coverage required?	No
Can it be deployed with an appropriate level of security?	Yes
Are there management tool available to minimize operational and deployment costs?	Yes

Ulrramesh[19]

Ultramesh provides wireless access points capable of supporting mesh types of architectures. The access points are based on off the shelf hardware components, such as motherboards, using 802.11-based interface cards. The hardware platform is operated with an open source Linux-based system from Locusworld in the United Kingdom (UK). This system appears to have a well-designed hardware and software platform allowing both for assembly from components for the wireless enthusiast and purchase of already assembled, ready to operate systems. The system specifications show that the wireless card used has a transmit power of two hundred milliwatts.

[19] Information about Ultramesh and related products and services can be found at www.ultramesh.com.

Moskaluk, Inc provides documentation for the hardware. This is an open source style of operation in the tradition of Linux. Managing a large number of these nodes appears to be a command line approach as no tailored management software is available. The key selling point of this product is the low cost. Two cities have implemented Ultramesh systems including Stevenson Oregon and Vivian Louisiana, both implementations based primarily on the desire for a low cost, high capability solution.

The open source nature of this product may not be suitable for an organization that does not have the technical depth to configure this system and manage the network with a command line interface. An evaluation of Ultramesh is shown in Table 2-8.

Table 2-8: Ultramesh Evaluation

Category	Evaluation
Will the solution support broadband data rates?	Yes
Can it be integrated into an overall system architecture?	Yes
Will it be reliable?	Questionable
Will it provide the coverage required?	Yes
Can it be deployed with an appropriate level of security?	Yes
Are there management tool available to minimize operational and deployment costs?	No

How Wireless Fits into the Overall Network Architecture

The architecture selected for Kirkland builds upon and adds to the existing fiber optic systems. The city has significant fiber optic resources and open ducts that are available to support additional deployed fiber. However, extending fiber connectivity to an ever-increasing number of user sites will generate significant additional costs. Wireless systems can be an alternative, supporting connectivity over the last mile link and providing an option that is both economical and capable of extending bandwidth to the end point device.

The general architecture recommended for Kirkland builds upon three interconnected network systems:

1. The backbone fiber optic network that provides high bandwidth along corridors of the city.
2. An intermediate (‘first level’) wireless distribution system between the fiber and the end point distribution system.
3. An end point (‘second level’) distribution system that supports a common wireless interface.

Figure 2.1 shows the system configuration. We recommend Gigabit Ethernet as the technology of choice for the backbone fiber optic network because of its high bandwidth and cost effectiveness.

For the wireless MAN (Metropolitan Area Network) or first level distribution system, we have identified a range of possibilities including both emerging standards-based products and currently available proprietary products.

Our choice of hot spot wireless technology or second level distribution system is based upon a Wi-Fi deployment because of its low cost and wide availability. In order to provide coverage over larger areas the city will require significant numbers of access points. We recommend that the access points be connected using a wireless mesh architecture. A mesh architecture makes use of a few access points connected as gateways to the Internet which wirelessly interconnect with the remaining access points, extending the coverage of the system.

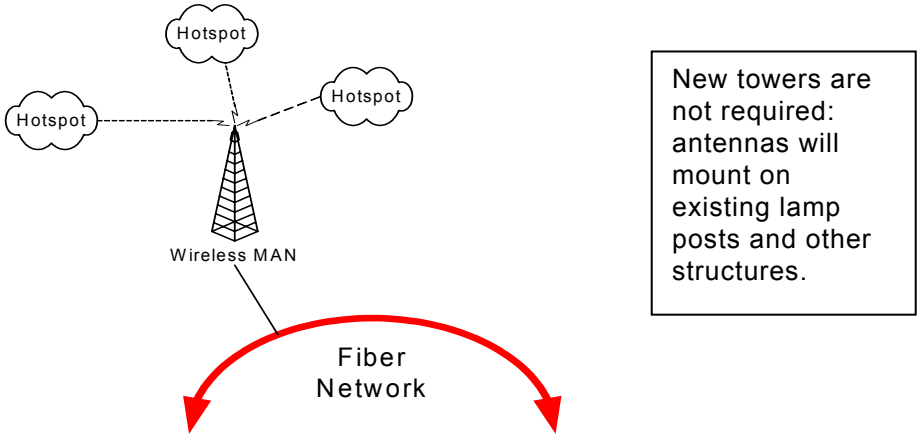


Figure 2.1: Proposed Wireless System Configuration

Two of the most common implementations of mesh architectures are those that use proprietary hardware to link end point devices and those that confine the mesh function to links between the access points and use a standard Wi-Fi connection from the access point to the end point device.

We recommend that an architecture implementing a mesh between only the access points is most appropriate. For the city the mesh concept can be appealing as it allows coverage of large areas with moderate amounts of bandwidth, minimizes cabling, and provides some limited mobility at a reasonable price. The mesh approach also allows the wireless system to maintain connectivity around some physical barriers. These barriers may be topology related (hills, structures) or areas of dense foliage. A mesh network is also capable of reconfiguring alternative paths should an interference source become present. Using mesh technology between only the access points permits end point systems to use standards-based hardware and software widely and easily available to all potential users

How Wireless Standards will Affect Available Wireless Architectures

Wireless system standards are rapidly evolving to provide standards-based approaches for both fixed wireless and mobile wireless services. Before building the wireless network, the City must assess the most current progress in the market for these devices. Following is an overview of the current wireless standards applicable to this network.

Wi-Fi Fixed Wireless: 802.11 a/b/g/n

The 802.11 Wi-Fi wireless standard continues to evolve rapidly providing higher speeds with vendors providing ever more creative solutions. The current 802.11 standard variants include:

- 802.11b – The first standard adopted providing about four to five megabits of throughput. This standard is declining as a technology platform as faster and more secure variants are developed.

- 802.11a – The second standard adopted providing about thirty megabits per second of throughput measured at a distance of fifty feet. This device uses the higher five-gigahertz frequency band that allows greater speeds, but supports shorter link lengths as the higher frequencies are more sensitive to degradation caused by building materials and foliage.

- 802.11g – The most current standard provides a hybrid approach supporting many of the features attributes of the 802.11a at the lower two-gigahertz frequency range used by the 802.11b equipment. This provides about eight-five percent of the throughput of the 802.11a equipment with the distance and propagation characteristics found with the 802.11b equipment. This standard is also interoperable with the earlier 802.11b devices.

- 802.11n – This standard will be ratified and appear in equipment during the coming year. The goal of the standard is to provide throughput similar to a one hundred megabit Ethernet link over a wireless network.

WiMax Fixed Wireless: 802.16a

The 802.16a standards, more commonly known as WiMax, continue to be expanded with some of the new WiMax technology now in the prototype and test phase. Over the next year it is anticipated that systems based upon the WiMax standards will become available. It is anticipated that WiMax based systems will be capable of some mobility through a modification of the existing technology. There is some speculation that this modification may provide a level of service that might minimize the need for additional mobile wireless standards.

Mobile Wireless: 802.16e, 802.20 & 3G

Mobile access takes two forms including:

- Full mobility that provides access in a moving vehicle
- Roaming within a hot spot area or between hot spot areas

Table 2-9[20] below provides an overview of selected architectures that are capable of support mobile IP-based communications:

Table 2-9: Mobile Data Architectures

802.16e	802.20	3G
IP 802.16a mobility (more than 1Mbps)	IP roaming & handoff (more than 1Mbps)	Circuit-switched cell data (less than 1Mbps)
Extensions to MAC and PHY from 802.16a	New MAC and PHY with IP and adaptive antennas	W-CDMA & CDMA-2000
Backward compatible with 802.16a	Optimized for full mobility	Evolving GSM or IS-41
Between 2-6 GHz	Licensed Bands below 3.5 GHz	Licensed Bands below 2.7 GHz
Packet Architecture	Packet Architecture	Circuit Architecture
Low latency	Low latency	High latency

802.16e is a variant of the 802.16a standard that is proposed with the ability to provide mobile access. This standard is targeted toward the 2 to 6 GHz frequency ranges that are currently being used to provide unlicensed services. A feature of this standard is the support for moving vehicles to about seventy miles per hour. As 802.16e is a modification of the 802.16a standard it may be ratified as a standard yet this year.

The 802.20 wireless standard is oriented towards providing broadband access to the fully mobile user with bandwidths in the range of 1 Mbps. The standard is target towards the frequencies in the 3.5 GHz area that provides access to the licensed carriers. One feature of this standard is the proposed support for moving vehicles to speeds over one hundred fifty miles per hour while providing Digital Subscriber Line (DSL) like bandwidth. As this standard is being developed new from the start it may be assumed that this standard will not be ratified before the 802.16e standard. It is most likely that equipment based upon the 802.20 standard will be installed as an overlay to the 3G cellular systems that are currently being installed. This standard is still in the development stage with no advertised equipment trials known to be in progress.

[20] http://www.dailywireless.org/modules.php?name=News&file=article&sid=1284. Michael van Noorden, Managing Director of Sevida, a consulting firm in the UK, provides Wi-Fi academy with interesting observations on the battle between mobilized 802.16e (using both licensed and unlicensed bands) and 802.20 (using licensed bands below 3.5 GHz) - for vehicular-speed handoff.

A technology similar to the functionality of 802.20 is being implemented by the cellular providers in the form of 3G (to include all the typical third generation cellular data protocols) services. This system is now providing wireless data services in select areas with typical data rates in the range of one to four hundred kilobits per second. Although 3G systems do not provide true broadband service, these offerings can be expected to be generally available throughout the county sometime in the near future. The 3G cellular systems will provide true mobility with the system tracking each user and performing periodic handoffs to maintain constant connectivity.

Wireless mobility for the end user takes two forms:

- Full mobility with constant connectivity such as provided by cellular systems. These 3G cellular systems provide moderate, always-on bandwidth by tracking the users device through a variety of means keeping a constant connection to a nearby point of access.
- Periodic, but regular, links to the network such as provided by LAN based wireless systems. Access to the network is at very high speeds, but will be interrupted as the user moves areas that are not covered. Interruptions take the form of the user moving from hot spot to hot spot as an example.

LAN-based wireless technology allows the laptop user to move to various locations within a hot spot area and still maintain connectivity to the Internet. However, if the user to moves to adjacent hot spot network connectivity may or may not follow requiring a logoff and logon cycle in order to reacquire connectivity. Wireless products available from companies such as Tropos, Belair and MeshNetworks can currently provide the ability to move within a hot spot while maintaining connectivity. New technology in the Ethernet network switches are being developed that allows a user to move between hot spots, or access points, as long as all of the access points receive service from the same chassis based switch. The next evolution of this process will be the ability to move between hot spots, or access points, that are served by different switches on the same backbone network. Some major switch vendors have announced this functionality as their future direction. Both hardware and software products can make this movement between hot spots appear transparent.

No one system will meet the needs of every user. Fully mobile service with moderate bandwidth may be obtained from the cellular companies; regular links to high bandwidth may be obtained through a link using a Wi-Fi or WiMax hot spot. Currently interfaces are being developed that will allow users to move seamlessly between technologies. For example, the Cisco 3200 router[21] supports multiple types of interfaces that will allow the mobile user to access a network using several different interfaces. The cellular based interface is active at all times while the 802.11 wireless interface active only when the Wi-Fi access point is available. This flexibility comes at a price with the mobile router starting at about six thousand dollars for the basic unit plus the monthly cellular costs.

[21] Information about the Cisco 3200 mobile router may be found at http://www.cisco.com/en/US/products/hw/routers/ps272/.

Several software programs can provide seamless connectivity for users as they move between access locations. Both NetMotion[22] Mobility XE and Padcom[23] TotalRoam will allow users to move between mobile access areas giving the user the appearance of seamless mobile access. As the user moves to a new access location the software will resume the previous function with no interaction from the user.

Conclusion

Our recommendations are that the configuration of the wireless network for the City of Kirkland be based upon a hybrid approach using the Motorola Canopy connecting to the fiber optic network and serving as the first level wireless transport for each nearby area. The selection between the Motorola and Alvarion units is relatively close with each product having technical advantages in certain situations. We also recommend that the Tropos product be connected to a Canopy client and act as the second level wireless transport in the network, providing the connection to end users using standards-based interface. The basis of these product selections are as follows:

Canopy

- The Canopy solution will support broadband connectivity. Canopy technology is competitive with other vendor solutions and provides adequate bandwidth and geographic coverage in support of the proposed system architecture. With over 100,000 units deployed worldwide it can be considered a reliable and proven product. The system is currently available in quantity.
- The Canopy solution provides a backhaul point-to-point link solution that provides high bandwidth, 20 Mbps, at a low price. This hardware platform is useful to provide wireless links to second level devices that are near an existing location with a fiber optic link.
- The installation of the system is plug and play with a moderate learning curve. An employee that can install a standard 802.11 wireless system can quickly learn the skills needed to install and support Canopy. Canopy has management tools to minimize operational and deployment costs.
- The system supports encryption and has features that can secure transmissions within the wireless network.
- The system scales easily. The use of GPS to coordinate the transmit and receive cycles allows the access points to be located close together without causing interference between the units.

[22] Information about the NetMotion Mobility products may be found at www.netmotionwireless.com.

[23] Information about the Padcom TotalRoam products may be found at http://www.padcomusa.com/products.shtml.

Tropos

- The Tropos system provides bandwidth to local municipal users or the public using standard and reliable off the shelf Wi-Fi components. It can be integrated into the system architecture and will support broadband connectivity at data rates exceeding 3Mbps.
- Should a closed network be required for the municipal organizations, the access points support 128-bit encryption.
- The product supports an access point based mesh architecture that allows the unit to provide support where access is planned in malls, downtown areas and parks where cabling is a problem or where a complex network may be required to overcome hills and other physical obstructions. Tropos networks have a network management package that enables management of the access points using a graphic user interface.
- Some degree of mobility can be added to the system using software products such as NetMotion.

3. Competitive Assessment

3.1 Competitive Framework

Providers can anticipate competition not only from existing providers but also from new entrants. For connectivity services, competition can be anticipated from the following approaches:

- **Cable Television:**

  DBS (Dish Network and DirecTV)
  DSL Providers
  LMDS Providers
  MMDS Providers
  Comcast

  Comcast has an operational two-way HFC system in Kirkland. From the channel lineups and FCC records, the system appears to be 860 MHz, with an average of 500 to 800 homes per node. Comcast offers a full cable television line-up, including four digital tiers and offers two-tier cable modem service in Kirkland.

  Direct Broadcast Satellite (DBS) offers an alternative to traditional cable television. With a smaller dish than its predecessors, aesthetics are not as strong an issue as in the past. Costs of DBS continue to decline. With digital quality, near-video-on-demand, and newly introduced two-way Internet access, we expect DBS to increase its share of the cable television market.

  A local multipoint distribution system (LMDS)[24] can offer an alternative to cable television. Due to equipment costs, however, LMDS is unlikely to become a cost-effective alternative to cable television but might be a competitive alternative for high-speed data connection services. Because LMDS operators must access fiber to implement their networks, they are not only competitors but also potential customers.

  A multipoint multiband distribution system (MMDS) provides a means for wireless cable television. License holders of MMDS frequencies are not pursing new markets, however, so no MMDS provider is likely to emerge in Bellevue and Kirkland.

  The provision of video programming over DSL should be able to compete with traditional cable television. Some independent phone companies (e.g., Wood County, Wisconsin; Clarion County, Pennsylvania) have successfully offered cable television services over telephone networks. Regional Bell Operating Companies (RBOC's) such as SBC, Qwest, and Verizon have not shown sustained interest in the cable television market.

[24] LMDS – A licensed wireless technology that can be used provide multimedia services. Licensed in the 27 to 31 GHz band.

- **Community Intranet:**

  Local Private Networks

  The City of Kirkland can consider creating a community Intranet over a Metropolitan Area Network (MAN). A community Intranet would be similar to the Internet except that access would be limited to Kirkland residences. Many businesses use an Intranet over their Local Area Network to distribute manuals and other information to their employees.

  No other provider is likely to provide these services directly.

- **Internet Access:**

  AOL
  DirecWay
  Earthlink
  Juno
  Comcast
  MSN
  Accel Net
  U.S. Link
  Other National & Local Providers

  In addition to high-speed Internet providers, another key source of Internet competition is the national and local providers who offer a low-priced dial-up service. The cost of Internet access over a new or enhanced network will be higher, so customers are unlikely to switch unless they perceive a higher value with a high-speed connection.

  Digital Subscriber Lines (DSL) and cable modems offer reliable and cost-effective Internet access. DSL is available in Kirkland from Verizon as well as several other service providers and resellers.

  T-1, frame relay, and ISDN access is currently available in Kirkland.

  DirecTV offers an Internet service that does not require use of a telephone line. These satellite options are available anywhere in Kirkland and are available for approximately $60 per month.

- **High-Speed Data Connection:**

  Comcast
  Verizon
  Wireless Data Services
  Trinity3
  Queenanne.net
  Accel Net

  As indicated under cable television, LMDS license holders are able to offer “wireless” T-1 and other services. Most business plans developed by the participants in the Federal Communications Commission (FCC) LMDS auction indicate that initial offerings of business data services are likely to be small to medium size.

  Verizon provides T-1 and other connectivity services in Kirkland.

- **Long Distance Telephone:**

  AOL
  MCI
  Sprint
  Verizon
  Others

  Large users of telephone services in Kirkland are likely to pursue or have already pursued discounted long distance services. Given the competition, long distance services are a commodity with low gross margins. In addition, the applicability of Internet-based long distance service is increasing due to vendor and technology developments. In five to ten years, long distance may be a no-cost or bundled service.

- **Local Telephone**

  Verizon
  Competitive Local Exchange Carriers
  Wireless Providers

  Contrary to popular belief, the incumbent telephone company is not the only competition for local telephone services. The capability and reliability of wireless services is increasing, and Personal Communications Service (PCS) providers have a long-term objective of becoming an alternative local telephone provider. Incumbent telephone providers have already seen a decrease in second line services due to wireless options.

  Local Telephone Companies

  There are over 460 Local Exchange Carriers (ILECs and CLECs) registered with the Washington Utilities and Transportation Commission.

  To compete with Verizon and the many competitive service providers in the Kirkland area, new entrants will need to obtain a large local or low-cost call area, and number portability will be essential. Otherwise, if a new entrant's local calling area is restricted to the city limits, the competition will have a perceived advantage. During the registration process and negotiation of interconnect agreements with Verizon, new entrants will need to address issues related to the local call area and number portability.

3.2 Porter's Five Forces (Barriers of Entry)

Barriers of Entry

To analyze barriers of entry with the connectivity business, we use Porter's framework, known as the Five Forces model, shown in Figure 3.1. This model focuses on five forces that shape competition within an industry.

1. Risk of new entry by potential competitors.
2. Degree of rivalry among established companies with an industry.
3. Bargaining power of buyers.
4. Bargaining power of suppliers.
5. Threat of substitute products.

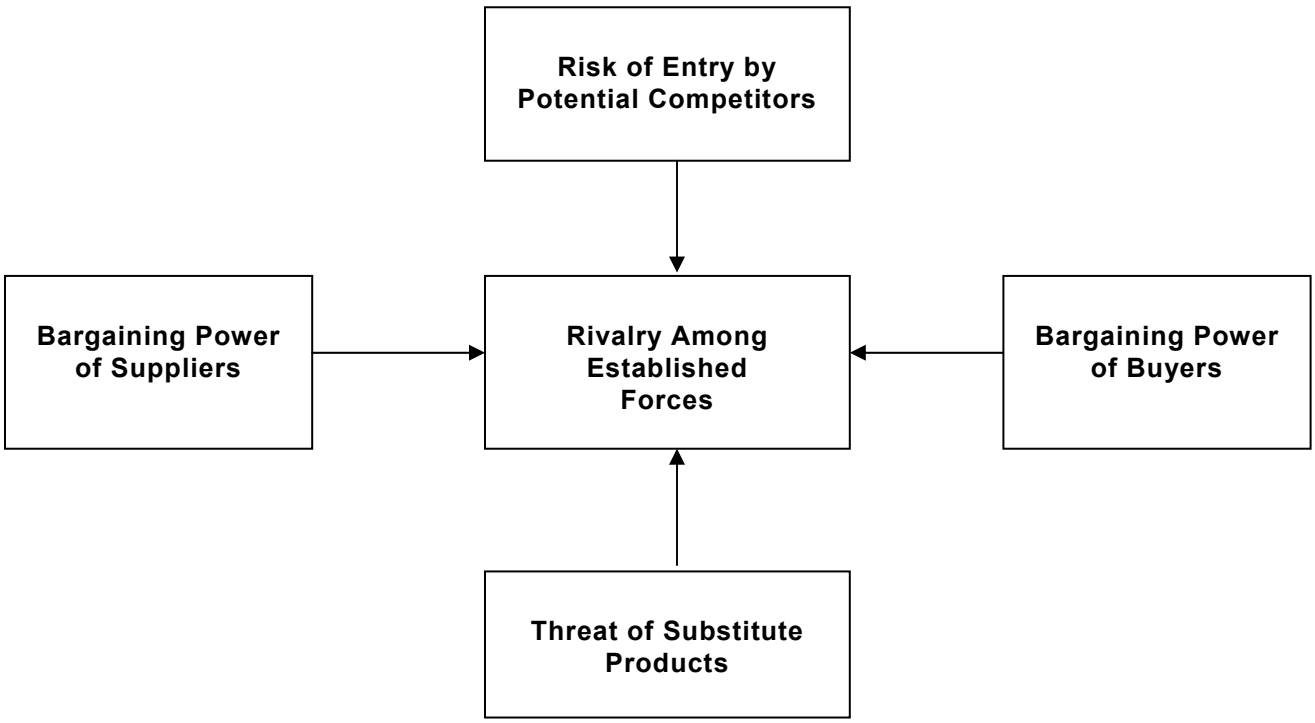


Figure 3.1: Five Forces Model

The stronger each of these forces, the more limited the ability of established companies to raise prices. A weak force is viewed as an opportunity, whereas a strong force is viewed as a threat.

We applied the Five Forces model to high-speed Internet, cable television, telephone, and Pay-Per-View product offerings in Kirkland. We considered brand loyalty, cost advantage and economies of scale of the existing providers as well as the potential for Kirkland to offer services.

Potential Competitors

Potential competitors are companies that are not currently competing in an industry but have the capability to do so if they desire. Potential competition for the Internet, cable television, telephone, and Pay-Per-View products are listed in Table 3-1. Existing competitors are summarized in the next section.

Table 3-1: Potential Competitors (New Entries)

Product	Potential Competitor
Cable Television	Cable Television Overbuilders CLECs (DSL)
High-Speed Internet	Cable Television Overbuilders CLECs (DSL) Local Provider – DSL Satellite[1] Wireless Providers
Pay-Per-View and Video-on-Demand	CLECs (DSL) Video Stores[2]
Telephone	Cable Television Overbuilders CLECs Comcast Non-Facilities Based Resellers Go-Wireless VoIP Resellers

[1] New satellite deployments including Low Earth Orbiting (LEO) based services.

[2] Video stores will need an access to a network to deploy a pay-per-view for Video-on-Demand service.

Note that these are *potential* rather than *existing* competitors. Existing competitors are listed in Tables 3-2 through 3-5.

Each *potential* competitor can be analyzed according to—

- *Brand Loyalty:* Buyers preferred for the products.
- *Absolute Cost Advantage:* Control of market and product fees.
- *Economics of Scale:* Number of subscribers served by the competitor.

In Table 3-2, we present our assessment of brand loyalty, absolute cost advantage, and economies of scale for each potential competitor.

Table 3-2: Ratings of Potential Competitors: Brand Loyalty, Absolute Cost Advantage, and Economies of Scale

	Rating		
Potential Competitor	**Brand Loyalty**	**Absolute Cost Advantage**	**Economies of Scale**
Cable Television Overbuilders	Low	Low	Low
CLECs (DSL)	Low	Moderate	Low
CLECs (Telephone)	Moderate	Moderate	Moderate
Local Providers—DSL	Moderate to High	Moderate	Moderate
Non-Facility Based Resellers	Low	Moderate	High
Satellite (LEO, Other)	Moderate	Moderate	Low
Video Stores	Moderate	Low[1]	Moderate
Wireless Providers	Low	Moderate	High

[1] High if an open access network is available in Kirkland.

As these ratings show, we feel Kirkland has a strategic advantage in terms of brand loyalty. It does not fare as well in terms of absolute cost advantage, however, so municipal low-cost strategies are not recommended. The cost advantage point is further strengthened by our ratings for economies of scale.

Existing Competitors

Existing competitors for the same services are listed in Table 3-3.

Table 3-3: Existing Competitors

Product	Existing Competitor
Cable Television	DBS Satellite (Dish Network, DirecTV) Comcast
High-Speed Internet	DirecTV Comcast Accel Net Queenanne.net Trinity 3
Pay-Per-View and Video-on-Demand	DBS Satellite (Dish Network, DirecTV) Comcast Video Stores[1]
Telephone	Verizon

[1] Via "Sneaker.net."

Each of these existing competitors can be analyzed according to the same three factors: brand loyalty, absolute cost advantage, and economies of scale (Table 3-4).

- *Brand Loyalty* – buyers preferred for the products
- *Absolute Cost Advantage* – control of market/product fees
- *Economics of Scale* – number of subscribers served by competition

In Table 3-4, we have our assessment for brand loyalty for each of the existing competitors.

Table 3-4: Ratings of Existing Competitors: Brand Loyalty, Absolute Cost Advantage, and Economies of Scale

	Rating		
Existing Competitor	**Brand Loyalty**	**Absolute Cost Advantage**	**Economies of Scale**
DBS Satellite (DirecTV DishNet)	Moderate	High	High
Local Providers	Moderate to High	Moderate	Moderate
Comcast	Low	High	High[1]
Go-Wireless	Moderate		
Queenanne.net		Moderate	Moderate
Verizon	Moderate	High	High
Video Stores	Moderate	Low	Moderate

[1] Cable television.

As with potential competitors, we feel Kirkland has a strategic advantage in terms of brand loyalty, but Kirkland Utilities does not fare well in terms of absolute cost advantage. Again, we do not recommend a low-cost strategy. Given the incumbents' cost advantage, Kirkland should consider strategies that will not initiate a price war. Again, the cost advantage point is further strengthened by our ratings for economies of scale.

Rivalry Among Established Companies

If rivalry among established companies is weak, companies have an opportunity to raise prices and earn greater profits. If rivalry is strong, significant price competition, including price wars, may result.

Key factors to consider when evaluating rivalry are—

- *Competitive Structure*: Number and size of companies in industry.
- *Demand Conditions*: Growing demand for a product tends to moderate competition.
- *Height of Exit Barriers:* How easy is it for a firm to exit the industry?

Rivalry will vary by product and service. Table 3-5 provides an overview of the conditions that affect rivalry.

Table 3-5: Conditions Affecting Rivalry

Product or Service	Competitive Structure (Number of Firms)	Demand Conditions	Height of Exit Barriers
Cable Television	Few	Flat or declining growth	High
Dial-up Internet	Large number	Flat or declining growth	Low
High-Speed Internet			
• Facility-Based	Few	Growing demand	High
• Resellers	Moderate number	Growing demand	Low
Telephone			
• Facility-Based	Few	Flat growth	High
• Resellers	Moderate number	Flat growth	Low

The rivalry force indicates that high-speed Internet may enjoy good margins in the first few years. Market pressures will reduce margins for telephone and cable television. Given the high exit barriers, however, incumbent providers will fight to maintain their market share, often suffering losses in the moderate term.

The Bargaining Power of Buyers

Buyers can be viewed as a competitive threat when they force down prices or demand higher quality and better service. Residential and smaller commercial buyers do not have enough market power to force the few suppliers of Internet, cable television and telephone products to reduce costs or improve services. Kirkland can leverage this to their advantage. By offering a higher quality product and service, they can capture a substantial market share of industrial customers.

Suppliers can also be viewed as a threat when they are able to raise the price a company must pay for the services they supply. The “goods” supplied and the power of suppliers are shown in Table 3-6.

Table 3-6: Bargaining Power of Suppliers

Product	Supplier	Bargaining Power
Cable Television	Programming (Content) Providers	High
Internet	Internet NAP & connection provider (Verizon, Other)	Low to Moderate
Pay-Per-View and Video-on-Demand	Cable Television providers (Comcast, other)	Moderate
Telephone	CLECs with Class 5 switch capacity	Moderate to High

The Internet has the most favorable conditions for keeping its suppliers in check. With high-speed services being offered in more markets, however, the opportunity for high margins is likely to be short-lived. Kirkland will see increasing fees from cable television content providers, which may threaten long-term margins for cable television.[25]

The final force to consider is the threat of substitute products, summarized in Table 3-7.

[25] The financial model assumes that price increases will offset increases in content fee and other expenses. If margins are not maintained, the projected rate of return will decline.

Table 3-7: Substitute Products

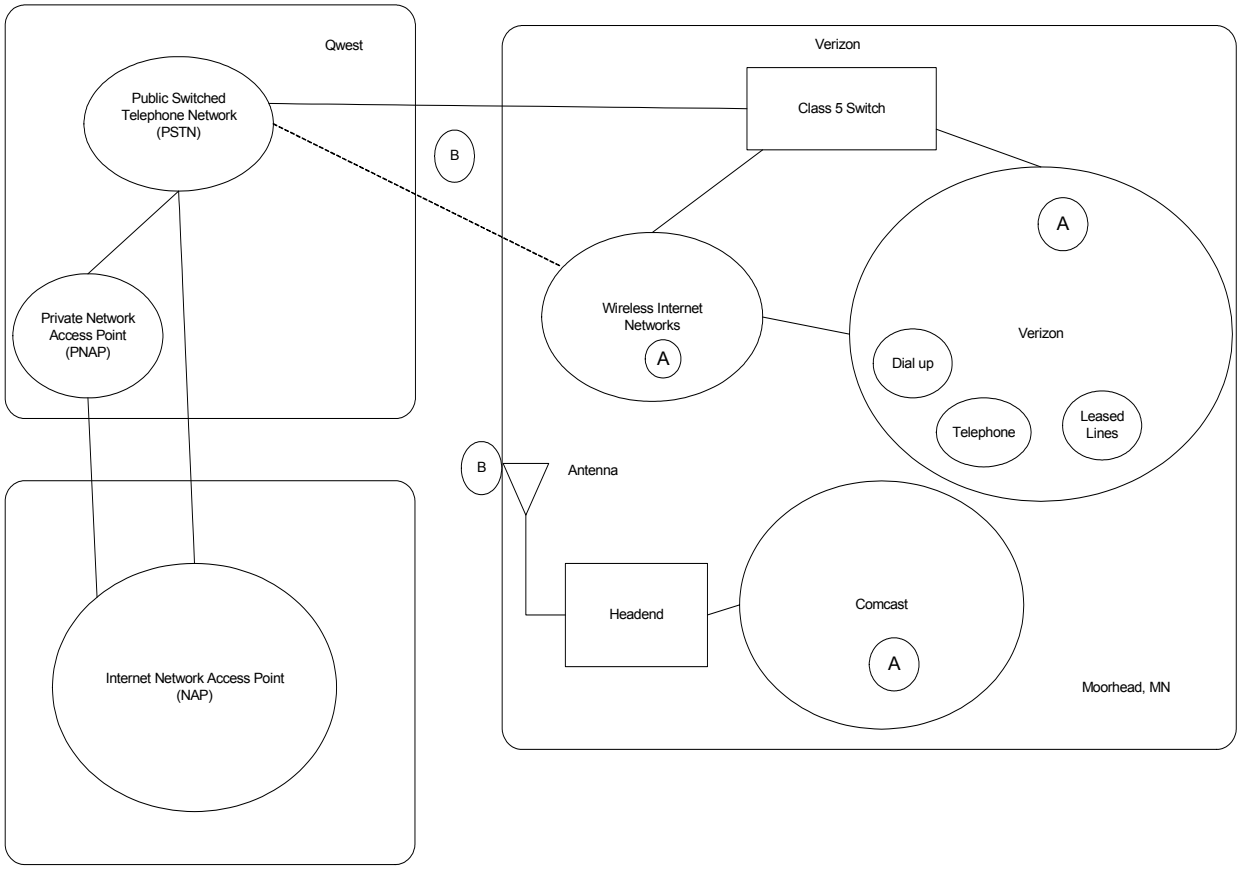
Product	Substitutes
Cable Television	Pay-Per-View/Video-on-Demand Satellite Off-Air Channels LMDS/MMDS Internet (Web Cast's) DSL
Internet	Satellite LMDS (Commercial Users) Unlicensed Wireless 3rd Generation Wireless Dial-up Service
Pay-Per-View and Video-on-Demand	DBS Satellite (DirecTV, Dish Network) Satellite
Telephone	Cellular & PCS Internet LMDS/MMDS
Video-on-Demand (VOD)	DBS Satellite (DirecTV, Dish Network) LEO Satellite Pay-Per-View/Video-on-Demand Video Stores

The Internet represents a threat to the cable television and telephone product lines. As high-speed connectivity increases, Internet threats to cable television and telephone will continue to rise. Wireless service is another threat to telephone. service. Wireless has already drastically reduced the number of second-line telephones and has begun enrolling the primary telephone market.

3.3 Incumbent Connectivity Providers

Before examining potential business models for connectivity services, we evaluate current connectivity service providers, data from residential and business surveys, business interviews, and other sources that provide information about current telecommunication providers.

Communities often face two infrastructure issues in delivering advanced connectivity services. The first is the infrastructure within the community (often referred to as the last mile). The second is the infrastructure to facilities outside of Kirkland. These two infrastructure issues are depicted in Figure 3.2.



A = Last Mile Infrastructure
B = Infrastructure connected to network outside of Kirkland

Figure 3.2: Connectivity Infrastructure

As seen in Figure 3.2, multiple connectivity infrastructures operate within the Kirkland community:

- Verizon and CLECs
- Comcast's cable system
- Wireless Internet

Each infrastructure is designed for a particular service. With the exception of wireless Internet, none of the infrastructures were originally designed for data transport. Although wireless Internet is designed for data transfer, it does have limitations on performance, especially for high-end data users.

As also shown in Figure 3.2, each infrastructure must connect to networks outside of Kirkland. Telephone and Internet rely on the infrastructure of Verizon, MCI, AT&T and other carriers. For cable television, programming is received from satellite broadcasts. Telecommunication services in the Kirkland community do not appear to be limited by the connections to areas outside the region.

This section reviews the key providers and the services they offer.

Cable Television

The franchising authority for cable television is that the City of Kirkland and Comcast have a franchise agreement to provide cable television services in Kirkland.

According to our residential survey, approximately 83 percent of households subscribe to cable or satellite television services. Of the cable subscribers, 87 percent (72 percent of all households) use Comcast and 13 percent (10 percent of all households) receive service from DirecTV or Dish Network.

Comcast's Basic Cable service includes 68 channels and costs $39.99 per month. Comcast also offers four digital packages, which increase in price with the number of premium services included. The four digital packages are summarized in Table 3-8. All digital packages also include up to 45 channels of commercial-free music services.

Comcast Inc.

- Based in Philadelphia, PA
- Serve communities in 38 states
- Serves close to 21,400,000 customers
- Offers full voice, video and data services to over 50% of the subscribers served
- Comcast cable modem subscribers make up over 19% of the high-speed Internet access in the US making Comcast the second largest ISP in the US (AOL has 28% of ISP Subscribers)

A set-top box is required for digital cable subscribers. The service charge for rental of the box is included in the monthly cost of service.

Comcast offers HDTV services in Kirkland for an additional $5.00 monthly for digital cable subscribers and an additional $6.75 for subscribers with analog cable services. A separate set-top box is required to provide the HDTV signal to a high-definition television. Currently, 13 channels are available in HDTV. The HDTV line-up includes six local and seven premium channels.

Table 3-8: Comcast Digital Packages

Package	Digital Channels	Premium Channels Included	Monthly Charges
Digital Plus	30 to 40	None	$55.98
Digital Silver	30 to 40	1	$66.98
Digital Gold	Over 40	2	$77.98
Digital Platinum	Over 40	5	$93.98

Content[26] fees are a substantial cost component of operating a cable television system. These fees have been increasing at a rate of over 10 percent per year, and on average range they account for 30–50 percent of a package's monthly price.

Comcast delivers cable television services over a Hybrid Fiber Coaxial (HFC) system. The HFC system deployed in Kirkland and surrounding areas is summarized below. This information is based on Comcast filings with the FCC and our review of Comcast's channel plans:

- 2-way, 860 MHz architecture
- Fiber nodes serving an average of 500-800 homes passed
- 78 analog channels plus digital tiers
- 19,800 customers (24,700 homes passed)

Through the use of upgraded Data Over Cable Service Interface Specifications (DOCSIS) Higher upstream capacity (the limiting factor in current HFC architecture) could be increased by using upgraded Data Over Cable Service Interface Specifications (DOCSIS) infrastructure and modems. Comcast will allocate an estimated 3.2 Mbps of upstream bandwidth to cable modem services. By applying 16QAM technology, Comcast would be able to provide a total of 10 Mbps of data payload on the upstream channel. This will provide full, allocated throughput to 78 concurrent users limited at 128 Kbps of upstream. Currently, an estimated 50 percent of cable modem users are online (connected to the Internet) at a time. Of these users, only up to 50 percent are concurrently active. With 690–716 homes per node, the Comcast network should be able to support cable modem penetration rates of up to 54 percent from the current take rate of 48 percent with minimum bandwidth allowances.

From survey results, we estimate that Comcast provides cable modem services to 27.6 percent[27] of homes passed. With the HFC system deployed, we expect that Comcast will need to aggressively manage the Internet services so that performance levels are not degraded.

[26] Fees paid on a per-subscriber, per-month basis to have the "right" to provide a channel such as ESPN, HBO, Fox Sports.

[27] Forty-eight (48) percent of the 83 percent of homes that have Internet access.

Satellite Television

In addition to Comcast, cable television service is available from Dish Network and DirecTV.

In Table 3-9, a summary of DirecTV's pricing is presented. Dish Network has a similar package and pricing structure. The installation charges, including equipment, is estimated at $134. Local channels are available via Dish Network and DirecTV in Kirkland.

Table 3-9: DirecTV Cable Television Packages (Partial List)[1]

Package	Features	Monthly Charges
Total Choice	• 105 channels, including music channels	$31.99
Total Choice—Starz	• 4 Starz channels • 8 Encore channels • 105 Total Choice channels	$41.99
Total Choice—Showtime	• 5 Showtime channels • 2 TMC channels & FLIX • 105 Total Choice channels	$46.99
Total Choice—Starz & Showtime	• 4 Starz • 5 Showtime • 8 Encore • 2 TMC channels & FLIX • 105 Total Choice channels	$56.99
Total Choice Platinum	• 105 Total Choice channels • Over 50 premium channels	$82.99

[1] DirecTV offers 10 packages that range from $31.99 to $82.99.

Internet Access

Unlike many communities across the country, Kirkland businesses and residents have a number of options for high-speed Internet access, including Digital Subscriber Line (DSL), cable modem, and wireless. There are also a number of local and national dial-up Internet providers in Kirkland. Dial-up service options range in price from $15 to $25 per month. Table 3-10 presents a summary of some of the service options offered by providers in Kirkland.

Table 3-10: Internet Providers

Provider	DSL Facilities Based	DSL Reseller	Cable Modem	Satellite	Dial-up Telephone	Wireless	ISDN, Frame Relay, Other
2Alpha		X					X
Accel Net						X	
AOL					X		
ATT Worldcom					X		
BTI Net		X			X		X
Comcast			X				
DirecTV-DirecWay		X		X			
Earthlink					X		
Electric Lightwave Inc.					X		X
IC&C Western	X						X
Inwa		X			X		
Meer.net		X			X		
MSN					X		
Northwest Nexus		X			X		
Queenanne.net						X	
US Link					X		
Verizon	X				X		X

Prices for each of the aforementioned services vary slightly among the providers. In the following tables, we summarize the Internet services offered by Verizon, Comcast, Queenanne.net, DirecTV and Starband.

In Table 3-11, we summarize Verizon's Internet services.

Table 3-11: Verizon DSL Internet Services and Monthly Charges

	Data Rate			
Option	Download	Upload	Monthly Charges	Comment
Verizon DSL Residential	1.5 Mbps	128 Kbps	$34.95	$29.95 offer for first three months
Verizon DSL Business	1.5 Mbps	128 Kbps	$59.95	One Dynamic IP Address. $89.95 for Static IP
Verizon DSL Business	384 Kbps	384 Kbps	$79.95	One Dynamic IP Address. $89.95 for Static IP
Verizon DSL Business	1.5 Mbps	384 Kbps	$89.95	One Dynamic IP Address. $119.95 for Static IP
Verizon DSL Business	768 Kbps	768 Kbps	$129.95	One Dynamic IP Address. $159.95 for Static IP
Verizon DSL Business	7.1 Mbps	768 Kbps	$204.95	One Dynamic IP Address. $234.95 for Static IP

Verizon also offers a variety of frame relay, ISDN, ATM, and other services that can be used for Internet access. Costs for these services start around $100 per month and can exceed $10,000 per month depending upon location, term of contract, management services, speed, and other options.

Table 3-12 presents a summary of Comcast's residential and commercial Internet services.

Table 3-12: Comcast Internet Services and Monthly Charges

Plan	Monthly Charges	Modem Rental (Optional)	Maximum Data Rate		Maximum Connected CPEs[2]
			Download	Upload	
Residential					
Standard	$32.95[1]	$5.00	3.3 Mbps	256 Kbps	1
Super User	$69.95[1]	$5.00	4.3 Mbps	384 Kbps	5
Commercial					
Standard (Small Office)	$79.95	$5.00	3.3 Mbps	256 Kbps	5
Small to Medium	Quoted	$5.00	4.3 Mbps	384 Kbps	20

[1] If subscriber does not have cable television from Comcast, an additional fee of $10 per month is applied.
[2] Customer Premises Equipment (Personal Computer [PC] or Other).

Queenanne.net is a wireless data connectivity provider from Seattle that offers a wireless T-1 service to business and residential customers. Queenanne.net's Internet services are summarized in Table 3-13.

Table 3-13: Queenanne.net Wireless Internet Services and Monthly Charges

Option	Data Rate (maximum)		Monthly Charges	Comments
	Download	Upload		
Residential	1.6 Mbps	1.6 Mbps	$140.00	For 1 Gigabyte of transferred data
Commercial	1.6 Mbps	1.6 Mbps	$249.00	For 2 Gigabytes of transferred data
			$349.00	For 4 Gigabytes of transferred data
			$499.00	For 7 Gigabytes of transferred data
			$699.00	For 10 Gigabytes of transferred data

Unlike most of the competing vendors, Queenanne.net has chosen to charge by the amount of data transferred across the network rather than the rate at which data is transmitted. This service is designed to be competitive with the local telco service provider T-1 or 1.5 Mbps data rate.

DirecTV (DirecWay) and Starband[28] Satellite services also offer high-speed Internet services. DirecWay charges start at $60 per month and offer asymmetrical[29] services similar to cable modems. Existing DirecTV customers with only video services would be required to change their antennas to support Internet access. Installation and equipment costs are estimated at $600. DirecWay services are summarized in Table 3-14.

Table 3-14: DirecWay Internet Services and Monthly Charges

Option	Data Rate (Maximum)		Monthly Charges	Comments
	Download	Upload		
Residential	500 Kbps	50 Kbps	$59.99	Install Charge $599.98
	169 Kbps Continuous			
Residential	500 Kbps	50 Kbps	$89.99	Install Charge $599.98
	350 Kbps Continuous			
Commercial	1 Mbps	100 Kbps	$129.99	Install Charge $999.98

[28] Not Dish Network; Dish Network does not offer a high-speed Internet access option.

[29] Services for which the downstream data rates are greater than the upstream rates. Typically rates are 512 Kbps downstream (to user) and 128 Kbps upstream (from user).

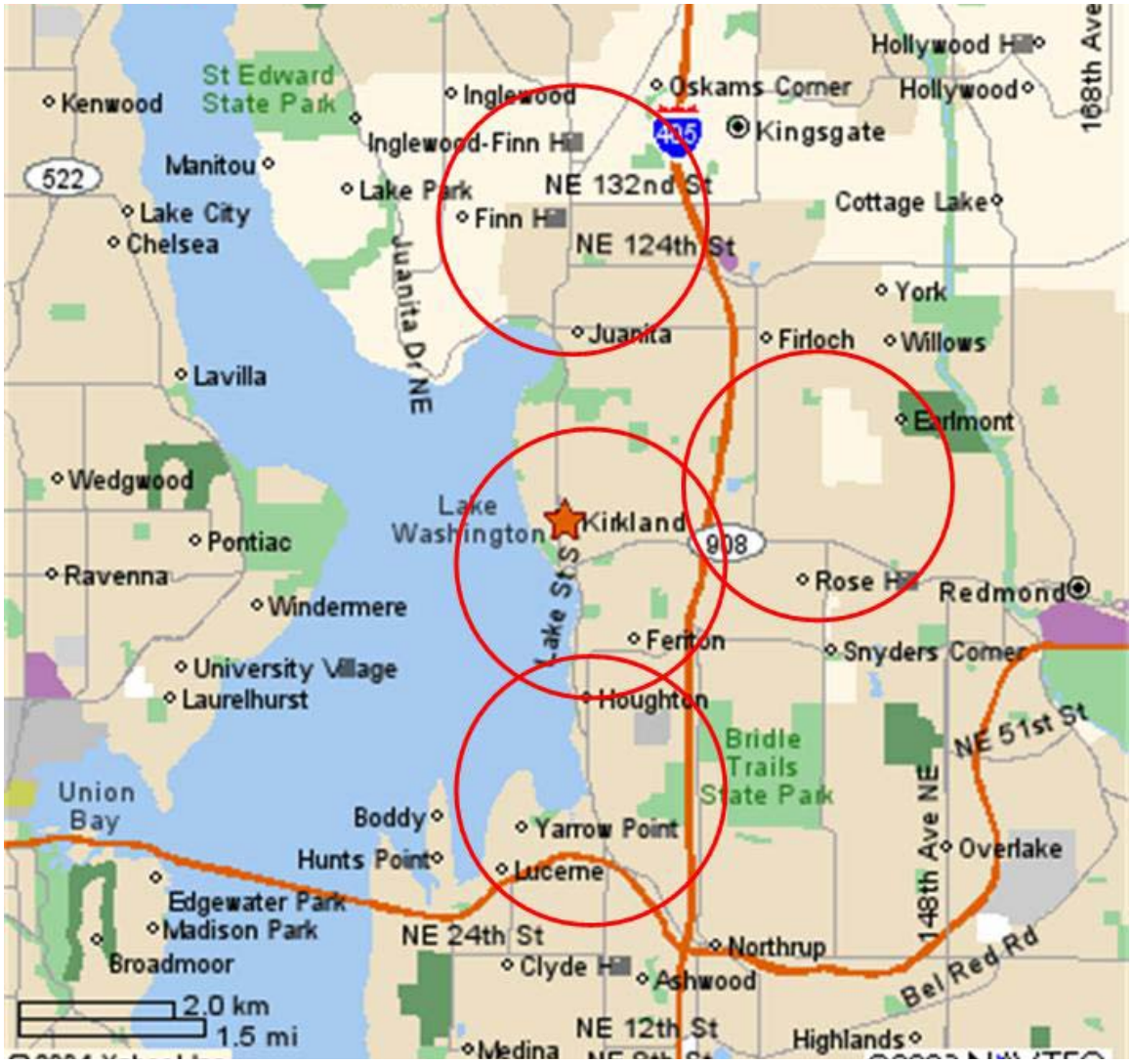
Services offered by Starband are summarized in Table 3-15.

Table 3-15: Starband Internet Offerings

Option	Data Rate (Maximum)		Monthly Charges	Comments
	Download	Upload		
Telecommuter	750 Kbps	100 Kbps	$109.99	Install Charge: $599.99
Small Office	500 Kbps	100 Kbps	$139.99	Install Charge: $599.99 Includes Network Router

As we have indicated, Verizon has several central offices that serve Kirkland, all of which support DSL services. Availability is limited, however, to businesses and households within 9,000–12,000 feet of the central office (actual copper distance, not straight-line distance). Figure 3.3 depicts estimated areas of availability for Verizon DSL service in Kirkland and surrounding area. As the figure shows, a large portion of Kirkland has reasonable Verizon DSL availability.

As seen in Figure 3.3, a large portion of Kirkland has reasonable Verizon DSL availability.



City of Kirkland: Verizon Digital Subscriber Line (DSL) Coverage
(All circles are 12,000' wireline planning distance.)

Red Circle: Central Office
No remote DSLAM locations provided
Each circle represents 12,000' of wireline planning distance

Figure 3.3: Verizon Estimated DSL Availability in Kirkland and Surrounding Areas

3.4 Service Provider Report

In this section, we provide an overview of Kirkland connectivity service providers, in the following order:

- Facilities-Based, Wireline Voice
- Facilities-Based, Wireline Internet
- Wireless Voice
- Wireless Internet
- Satellite Internet
- Cable Voice
- Cable Modem Internet

Facilities-Based, Wireline Voice Service Providers

Verizon Northwest
1800 – 41st Street
Everett, WA 98201
800.483.4100

Verizon Northwest is the incumbent Local Exchange Carrier (ILEC) in Kirkland, Washington, and offers a broad range of basic local voice services and packaged long distance voice services for both business and residential customers. Internet access and services are outlined in the next section.

Table 3-16

Service	Data Rate	Monthly Charges	
		Residential	Commercial
Voice Grade	Single Voice Line	$27.95	$26.02 to $39.20
Voice T-1	24 Voice Circuits		$422

Level 3 Communications
1000 Denny Way
Seattle, WA 98109
206.652.5600

Level 3 Communications is a high-capacity and backbone service provider oriented toward business class and "carrier's carrier" services. Level 3 is included as an example of high-capacity circuit scale and pricing.

Table 3-17

Service	Data Rate	Monthly Charges	
		Residential	Commercial
Voice Grade			$38.95
Voice T-1	1.544 Mbps		$425
DS-3	45 Mbps		$875
OC-12	622 Mbps		$7,900
OC-48	2.4 Gbps		$23,000

Electric Lightwave, Inc.
1218 3rd Avenue, # 915
Seattle, WA 98101-3021
206.812.2000

Electric Lightwave is a communications provider focused on small to medium bandwidth–intensive businesses. The company operates its own MANs based on SONET and DWDM technology and offers services from analog and digital lines to high-capacity connectivity.

Table 3-18

Service	Data Rate	Monthly Charges	
		Residential	Commercial
Voice Grade			$32
Voice T-1	1.544 Mbps 24 Voice Circuits		$410

XO Communications
7311 148th Avenue NE
Redmond, WA 98052-4148
425.702.0983

XO Communications is a Tier 1 telecommunications provider that provides communication solutions exclusively for businesses and other carriers. XO delivers a variety of services ranging from local to long distance telephone service and DSL to dedicated Internet access.

Table 3-19

Service	Data Rate	Monthly Charges	
		Residential	Commercial
Voice Grade			$28
Voice T-1			$454
OC-3 to OC-48f			Quoted

Facilities-Based, Wireline Internet Service Providers

Covad Communications
12131 113th Avenue NE
Kirkland, WA 98034-6944
425.825.8444

Covad is a primary facilities-based service provider for many of the resellers in the Kirkland, Washington area. Covad offers a wide range of xDSL services and several T-1 and Fractional T-1 connectivity solutions for Internet access. The company's equipment is typically co-located at the local telephone operation's facilities (Verizon Central Office) and uses the telco's copper lines to reach the end subscriber. Many resellers of Covad services either lease or build backbone facilities to the local central office, and Covad leases the subscriber interface equipment and last-mile connectivity to the reseller to reach the subscriber.

Table 3-20

Service	Data Rate	Monthly Charges	
		Residential	Commercial
Fractional T-1	384 Kbps		$369
	768 Kbps		$479
	1.544 Mbps		$549
T-1	1.544 Mbps		$379
SDSL	144 Kbps		$154.95
	384 Kbps		$174.95
	768 Kbps		$224.95
	1.5 Mbps		$314.95

New Edge Networks
20033 NE 194th Street
Woodinville, WA 98077-8875

New Edge Networks integrates a wide variety of last-mile broadband access services available through multiple carriers, technologies, and geographic regions worldwide. Its customers include telecom carriers, small to midsize businesses, and large corporations. This company has been instrumental in extending DSL capabilities through installation of extended range equipment in many local telephone companies nationwide.

Table 3-21

Service	Data Rate	Monthly Charges	
		Residential	Commercial
"Burstable" T-1	384 Kbps – 1.5 Mbps		$394.94 – $694.95
SDSL	144 Kbps		$120
	384 Kbps		$150
	768 Kbps		$200
	1.1 Mbps		$250
SOHO SDSL	192 Kbps – 1.5 Mbps		$79.95 – $274.95

Verizon Northwest
1800 – 41st Street
Everett, WA 98201
800.483.4100

Verizon Northwest is the incumbent local exchange carrier (ILEC) in Kirkland, Washington, offering a broad range of DSL and direct connect Internet access services for both business and residential customers. The company's DSL offering scales to much higher bandwidth than seen with most CLEC or other ILECs in the area.

Table 3-22

Service	Data Rate (Maximum)		Monthly Charges	
	Download	Upload	Residential	Commercial
DSL	1.5 Mbps	128 Kbps	$34.95	$59.95
DSL	384 Kbps	384 Kbps	na	$79.95
DSL	1.5 Mbps	384 Kbps	na	$89.95
DSL	768 Kbps	768 Kbps	na	$129.95
DSL	7.1 Mbps	768 Kbps	na	$204.95

XO Communications
7311 148th Ave NE
Redmond, WA 98052-4148
425.702.0983

XO Communications is a Tier 1 telecommunications provider that provides communication solutions exclusively for businesses and other carriers. XO delivers a variety of Internet access services ranging from DSL to direct connect solutions.

Table 3-23

Service	Data Rate	Monthly Charges	
		Residential	Commercial
Fractional T-1	384 Kbps – 768 Kbps		$299 – $584
Full T-1	1.544 Mbps		$640 – $895
IDSL	144 Kbps		$120
SDSL	384 Kbps		$150
	768 Kbps		$200
	1.1 Mbps		$250

Wireless Voice Service Providers

A broad range of wireless voice service providers offer services in Kirkland. We identified tower locations serving the Kirkland area for the following companies:

- AT&T Wireless
- Cingular Wireless
- Nextel Communications
- Qwest Wireless
- Sprint PCS
- T-Mobile
- TracFone
- Verizon Wireless
- Virgin Wireless
- VoiceStream Wireless

We did not conduct any additional research for wireless voice vendors because wireless voice service providers are outside of the scope of this evaluation.

Wireless Internet Service Providers

Accel Net, Inc.
14705 216th Avenue NE
Woodinville, WA 98072
425.844.8845

Accel Net provides high-speed wireless local-loop communications services to small businesses, home offices, residential users, apartment buildings, hotels, motels and office complexes. Pricing is quoted based on the number of subscribers and data utilization incurred.

Table 3-24

Service	Data Rate (Maximum)	Monthly Charges	
		Residential	Commercial
Fixed Wireless	3.5 Mbps – 10 Mbps	Rates quoted based on utilization	
Direct Connect Wireless	8 Mbps – 100 Mbps	Rates quoted based on utilization	

Queenanne.net
(Cortland Communications)
5416 Delridge Way SW
Seattle, WA 98106-1478
206.219.3802

Queenanne.net is a wireless data connectivity provider from Seattle that offers a wireless T-1 equivalent service to area business and residential customers with line-of-sight to one of their tower locations.

Table 3-25

Wireless Service	Data Rate (Maximum)		Volume	Monthly Charges	
	Download	Upload		Residential	Commercial
Residential Fixed	1.6 Mbps	1.6 Mbps	1 Gb	$140	
Commercial Fixed	1.6 Mbps	1.6 Mbps	2 Gb		$249
	1.6 Mbps	1.6 Mbps	4 Gb		$349
	1.6 Mbps	1.6 Mbps	7 Gb		$499
	1.6 Mbps	1.6 Mbps	10 Gb		$699

Satellite Internet Service Providers

Direcway
11717 Exploration Lane
Germantown, MD 20876
866.825.4950

Table 3-26

Service	Data Rate (maximum)	Monthly Charges	
		Residential	Commercial
Residential		$59	
Business	400 Kbps		$199
Business Plus	750 Kbps		$479
Business Premium	1 Mbps		$879
Required Equipment		$579	$8,999

Infosat Telecommunications USA
David Orton
PO Box 2268
Blaine, WA 98231
604.523.4116

Table 3-27

Service	Data Rate (maximum)		Monthly Charges	
	Download	Upload	Residential	Commercial
Standard Package	128 Kbps	500 Kbps	$149	$149
Required Equipment			$1,595	

Starband
Sheila Blackwell
1760 Old Meadow Road
McLean, VA 22102
703.245.6410

Table 3-28

Service	Data Rate (maximum)		Monthly Charges	
	Download	Upload	Residential	Commercial
Starband 360	150 Kbps	500 Kbps	$49.95	$149.99
Starband 480	150 Kbps	500 Kbps		
Required Equipment			$199 – $699	$499.99

SkyFrames, Inc.
555 Anton Boulevard
Costa Mesa, CA 92626

Table 3-29

Service	Data Rate (maximum)		Monthly Charges	
	Download	Upload	Residential	Commercial
	64 Kbps	1 Mbps		$425
	128 Kbps	1 Mbps		$775
	256 Kbps	2 Mbps		$1,475
	384 Kbps	2 Mbps		$1,975
Required Equipment				$7,999

Tachyon
Andrew Wheeler
5808 Pacific Center Boulevard
San Diego, CA 92121
973.994.4696

Table 3-30

Service	Data Rate (maximum)		Monthly Charges	
	Download	Upload	Residential	Commercial
	1.544 Mbps	512 Kbps	$500 – $1,000	$500 – $1000

Cable Voice Service Providers

Comcast
2233 112th Ave NE
Bellevue, WA 98004
425.462.2863

Comcast Cable offers up to four local phone lines and packaged rates including long distance services as part of expanded services across their HFC (Hybrid Fiber Coax) network.

Table 3-31

Service	1 Line	2 Lines	3 Lines	4 Lines
Local Service Only	$23.95	$33.95	$43.95	$53.95
180 Minutes	$33.95	$40.95	$47.95	$54.95
300 Minutes	$38.95	$45.95	$52.95	$59.95

Cable Modem Internet Service Providers

Comcast
2233 112th Ave NE
Bellevue, WA 98004
425.462.2863

Comcast Cable is the incumbent cable television provider in Kirkland and offers high-speed cable modem Internet access as part of its service suite. Comcast offers both residential and business service levels and pricing.

Table 3-32

Service	Data Rate (maximum)		Monthly Charges	
	Download	Upload	Residential	Commercial
Residential Standard	256 Kbps	3.3 Mbps	$32.95	$79.95
Residential Super User	256 Kbps	4.3 Mbps	$69.95	Quoted

Millennium Digital Media
3633 136th Pl SE
Bellevue, WA 98006-1451
425.747.4600

Millennium Digital Media is a cable television overbuilder in Bellevue, Washington. The company primarily offers services in the high-density residential areas of downtown Bellevue.

Table 3-33

Service	Data Rate (maximum)		Monthly Charges	
	Download	Upload	Residential	Commercial
Residential Light	64 Kbps	128 Kbps	$29.92	
Residential Standard	128 Kbps	1.5 Mbps	$49.95	
Business Silver	256 Kbps	1.5 Mbps		$79.95
Business Gold	512 Kbps	1.5 Mbps		$109.95
Business Platinum	1.0 Mbps	1.5 Mbps		$149.95

4. Market Assessment

4.1 Internet Survey

In conjunction with the telephone and written surveys, we gave Bellevue and Kirkland citizens and businesses an opportunity to make their voices heard through an Internet survey. Although the Internet survey results are not statistically valid because they are skewed toward high-end users, they do provide insight into the range of opinions and possibilities.

Comments we received from the Internet surveys are summarized in this section under two groups:

1. **Pros:** Benefits and Comments in support of the City's Involvement
2. **Cons:** Concerns Regarding City Involvement

Although the comments we received vary widely, some common themes are clear:

- Concern with the increasing rates for cable television service.
- Frustration with the lack of programming options (customer choices) offered by Comcast.
- Impressions that the availability of DSL or cable modem services is spotty.
- Support for city efforts to advance services—with caution.

Note that channel selection options and rising cable television rates are not issues that the City of Kirkland can address. Although the franchise agency is the City of Kirkland, pricing and channel lineup options are not negotiable (under Federal Communications Commission [FCC] regulations). Further, if the City of Kirkland became a cable television provider, it would be faced with the same issues faced by current cable television providers. The "content" or ownership of programs dictate the channel lineups and have been raising subscriber fees by over 10 percent annually for the past five to ten years.

Benefits and Comments on the City's Involvement

- "Become a provider only if it is to offer more affordable service than currently offered."

- "Reserve a megabit for each household/taxpayer, free (not ISP, just a bit pipe around town). Put switches in neighborhoods, every X hundred meters."

- "Deploy a wireless network."

- "If taxes go to subsidize access to low income families then I would be much more willing to use taxes as part of the equation."

- "Security is the top priority for the business that I am in. Also, keeping service running at all times with no interruptions. A day with out the Internet would be extremely damaging to business."

- "The information received (and produced) by people obviously has a huge impact on political, economic, cultural, etc. outcomes. Over decades it has become clear the owners of the physical spectrum, media and Internet are in a position not only to extract the wealth inherent in many of these decisions but to encroach on the political freedom and cultural health of the community. Efforts to regulate, censor etc. corporate or privately owned networks always run into property rights and freedom of speech. Citizens must own and operate *directly* the last few hundred meters in order to assure healthy dissemination of information and we must own the municipal area network in common thru the City of Kirkland. Build us a bit pipe around the edge of the Internet. Do not entrust our economic or political future in the hands of future City officials--who will inevitably, succumb to temptation to control content and behaviors on the network-- by operating an ISP service. Just let the data flow. There are already plenty of providers of Internet gateways, e.g., all the CLECs who have been screwed out of the business."

- "I would like to see Council meetings and other streaming video available on the WWW in addition to Ch 21. Those of us with Direct television do not have any other way of receiving this feed."

- "I like the idea of the city connecting all residences/businesses with high-speed/broadband fiber-optic cable that can deliver: voice (telephone); video (television, movies); and data (Internet). Hopefully, the access providers would be forced to provide more content/service bang for the buck because none of them would have the monopoly that they now have for a given residence/business location."

- "I am very frustrated with Comcast. I have repeatedly requested service to be provided to my home for cable television and Internet access. I have even tried to get them to provide me service when I had a trench dug to install gas and sewer to my home with no success. I would like the city to help consumers engage with all service providers to service all customers equally. If I required a telephone, the phone company would provide service. Comcast should be required to provide service in the same manner."

Concerns Regarding City Involvement

- "I just spent 10 minutes answering questions from a telephone interviewer and was only, according to her, 1/2 way done. I just gave up. Most of the questions were so general I give couldn't give an honest answer of how they apply to my company. This is just idiotic. If this is the way the City of Kirkland has been spending its resources then it's easy for me to understand why they're is such financial poor shape. Here's the services us Citizens want from the City of Kirkland, Police, Fire, see to it the Garbage is picked up, a few common sense regulations and maybe some parks. Eliminate funding of all the other crap going like this dumbass idea. I bet $1500 of taxes were wasted in creating this Web page."

- "This is a tricky issue. Anything that Kirkland does as a public entity will have to stand the test of comparison against market forces. There are benefits in working together for the common "wealth" and benefits in minimizing government. Any service that the government provides that is also provided by the marketplace needs to be well-justified. The benefits need to be overwhelmingly convincing - especially in a day when too many people want to cut taxes even at serious cost to their well-being."

- "I am begging you to STOP TAXING THE LIVING HELL OUT OF US! I do not want to have the city provide any services that require additional taxes - I feel I am over-taxed as it is, and I do not feel I am serviced adequately with the already expensive services provided. If it doesn't save the city of Kirkland money so they can reduce our taxes - then I DON'T WANT IT. About the only thing I am willing to be taxed for is to get a sidewalk in front of my house! That's it. DO YOU HEAR WHAT I AM TYPING?"

- "Why should the city provide services at similar prices? What would be the benefit in the that?"

- "KGOV is useless to satellite television subscribers or off-the-air only households."

4.2 Residential Market Assessment

Kirkland Residential Needs Assessment

The findings that follow are based upon a telephone survey conducted in February and March 2004. The survey resulted in responses from 250 Kirkland residences. The confidence interval for 250 responses at a 95 percent confidence level is ±6.2 percent. In other words, one can estimate that 19 times out of 20, the true characteristic of the entire population is within ±6.2 percent of what the survey data indicate.

To reflect the general population, we weighted residential data by age using year 2000 census information.

Market

Currently 92 percent of residents have Internet service at home (see Figure 4.1) and 17 percent of those without Internet access plan to get it in the next year. Almost two-thirds of residents with Internet access are using a high-speed connection and only 38 percent currently use a dial-up connection. The result is that 61 percent of all Kirkland residents use a high-speed alternative such as DSL or cable modem. This is significantly higher than the national average of about 20 percent.[30]

[30] 23 million US households have high-speed access (Matt Richtel, In a Fast-Moving Web World, Some Prefer the Dial-Up Lane. New York Times, April 19, 2004). In 2002, there were 108.5 million households in the U.S. (U.S. Census Bureau).

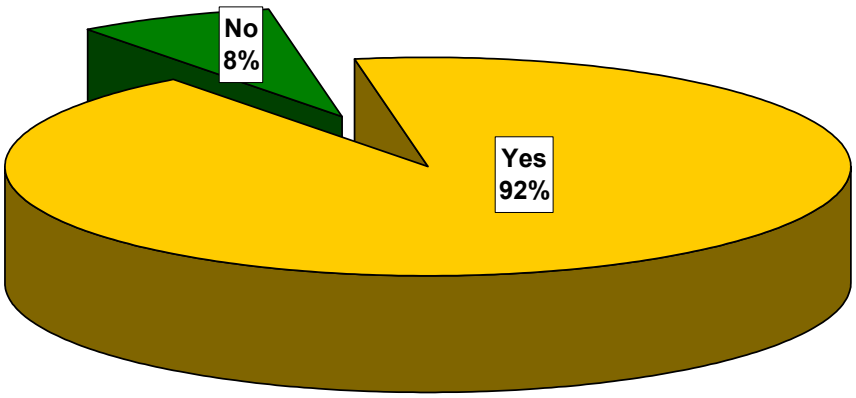


Figure 4.1: Internet Access

Most high-speed users pay on average $41 per month, while most dial-up users pay an average of $15 per month. Residents without Internet access cited such reasons as not having a computer (61 percent); feeling they have no need for the service (27 percent); or not worth the price (10 percent).

Current Users

Ninety-four (94) percent of residents (see Figure 4.2) reported that they have a personal computer (PC) in their home. Of those with a PC, 37 percent reported that they have a laptop computer.

As Figure 4.3 shows, of those residents without a PC in their home, 76 percent reported they feel no need for a computer and 12 percent said it is not worth the price.

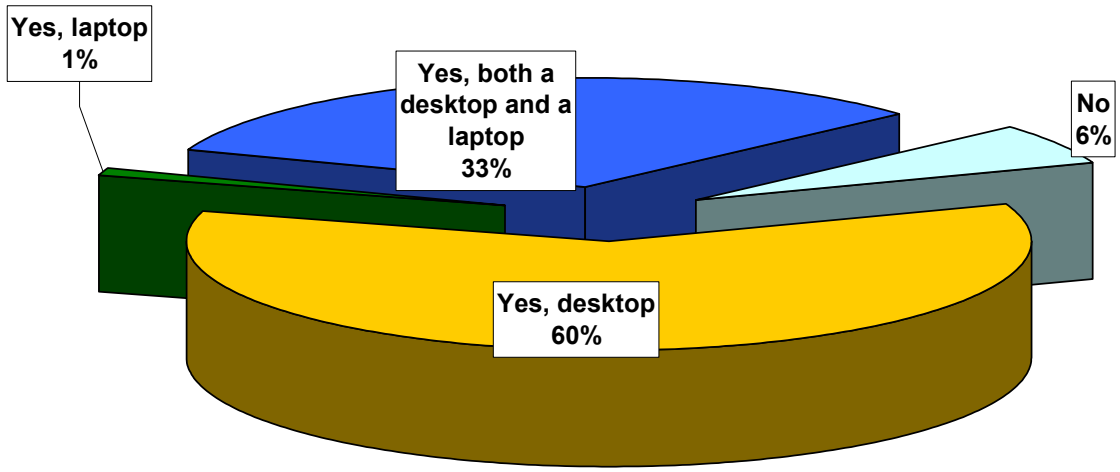


Figure 4.2: PC in the Home

The availability of laptops is not significantly higher than what we have seen in other regions of the country. For example, in our market research in conjunction with LinkMichigan last year, we found that 44 percent of households had access to a laptop.

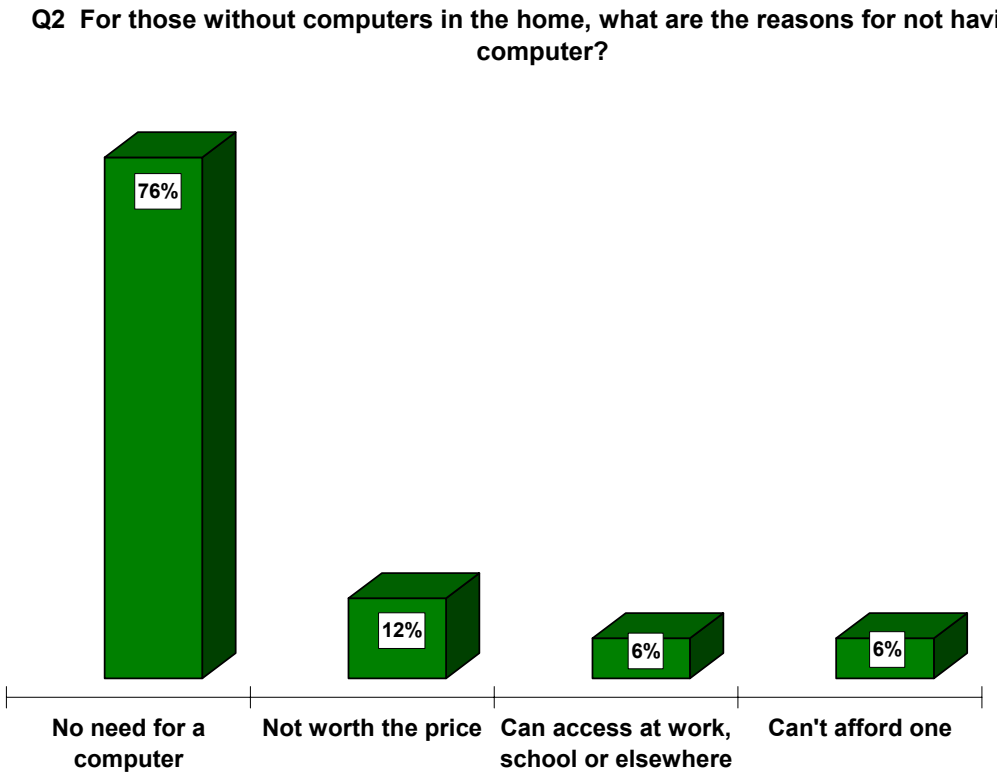


Figure 4.3: Reasons for not Having a PC

Of those without Internet access, 61 percent do not have it because they do not have a computer. Of those without Internet access, 27 percent expressed that they feel no need for one. Figure 4.4 shows the reasons cited for not having Internet access.

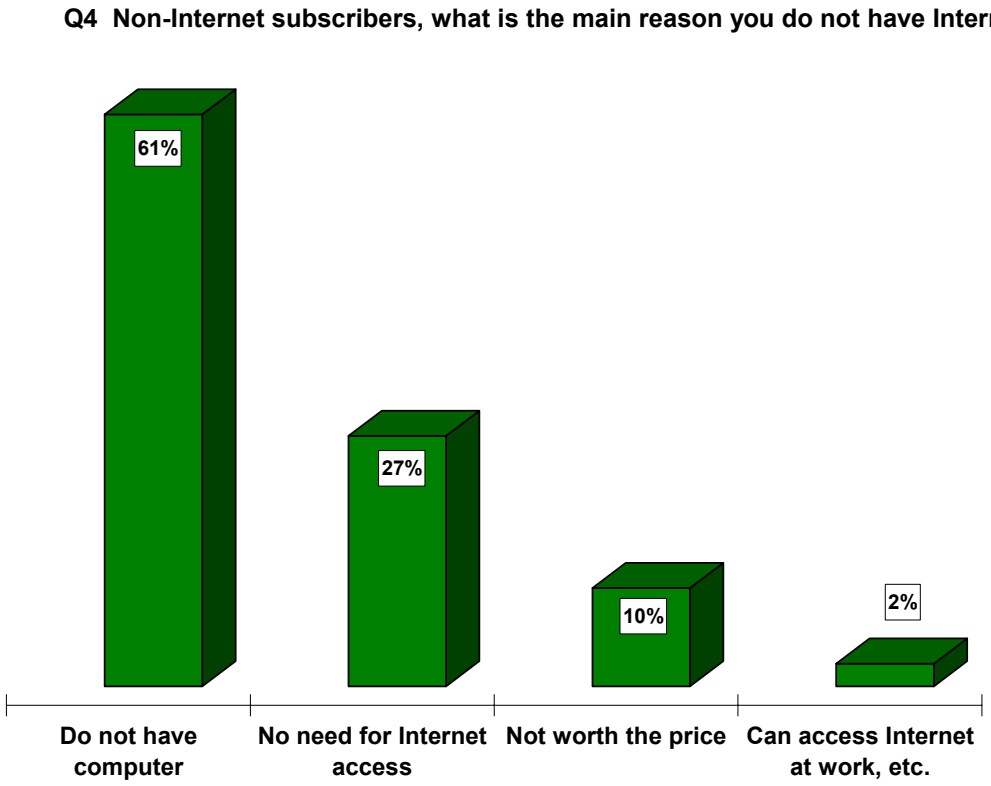


Figure 4.4: Reasons for not Having Internet Access

As seen in Figure 4.5, 60 percent of those without Internet access do not plan to obtain access in the next year. In other words, most respondents who do not already have Internet access do not plan to get it. This represents less than 5 percent of total households.

Q5 Non-Internet subscribers, do you plan to obtain Internet access in the next year?

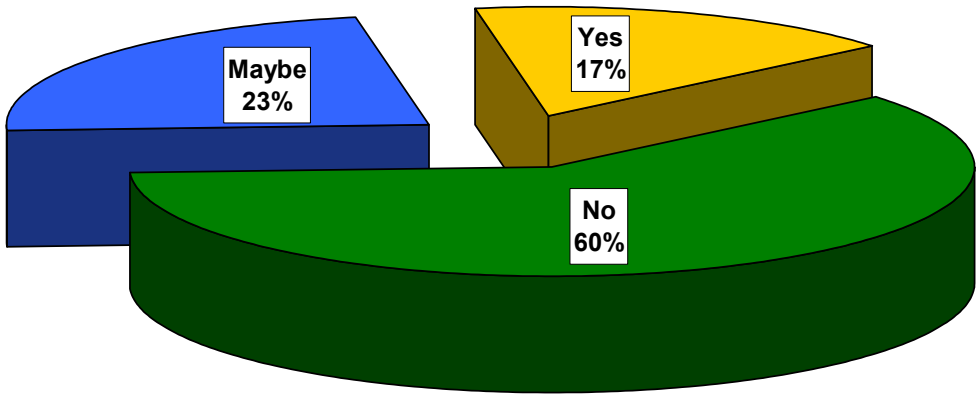


Figure 4.5: Plan to Get Internet

Sixty-five (65) percent of residents who have Internet access connect using a high-speed alternative, which includes using a cable modem, DSL or wireless. This represents 61 percent of total households—over three times the national average. The type of Internet access used is shown in Figure 4.6.

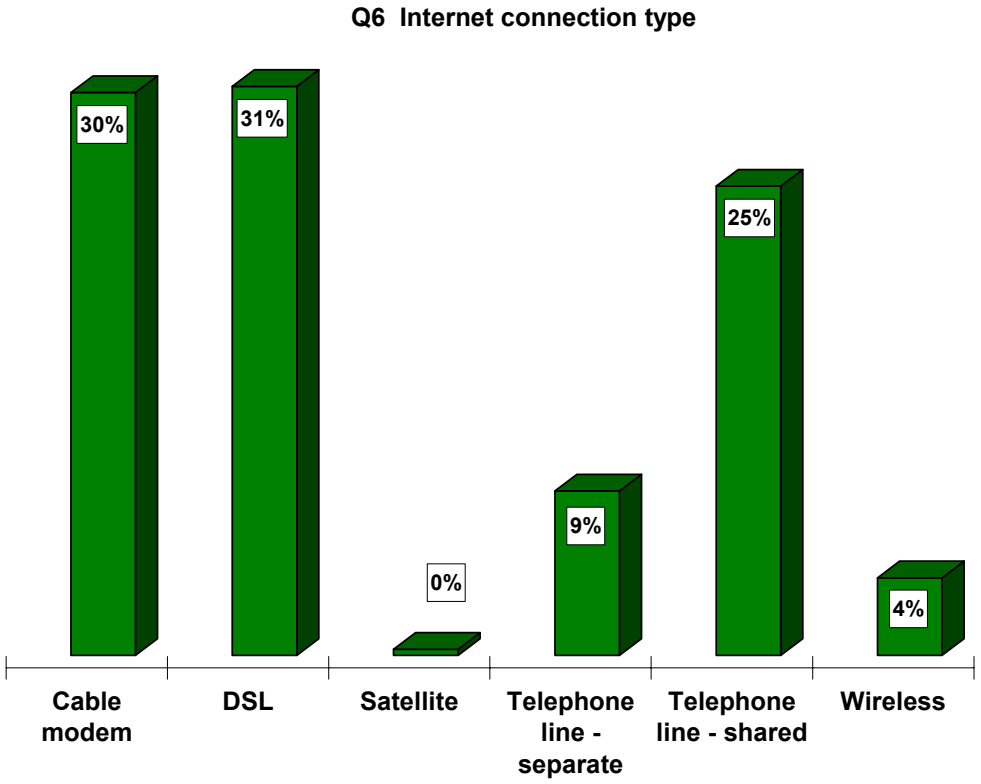


Figure 4.6: Internet Access Type

Forty-one (41) percent of Kirkland residents with Internet access would be willing to switch to an Internet service that offers increased connection speed with being online all the time for the same price; 12 percent would switch for a 10 percent increase in price. If high-speed access were priced the same as dial-up, the overall percent of Kirkland residents with high-speed alternative might rise from 60 percent to 73 percent (based on the survey results). As seen in Figure 4.7, users are quite sensitive to even a small price increase. For Kirkland to consider a residential Internet offering, attraction of customers based on price might be required.

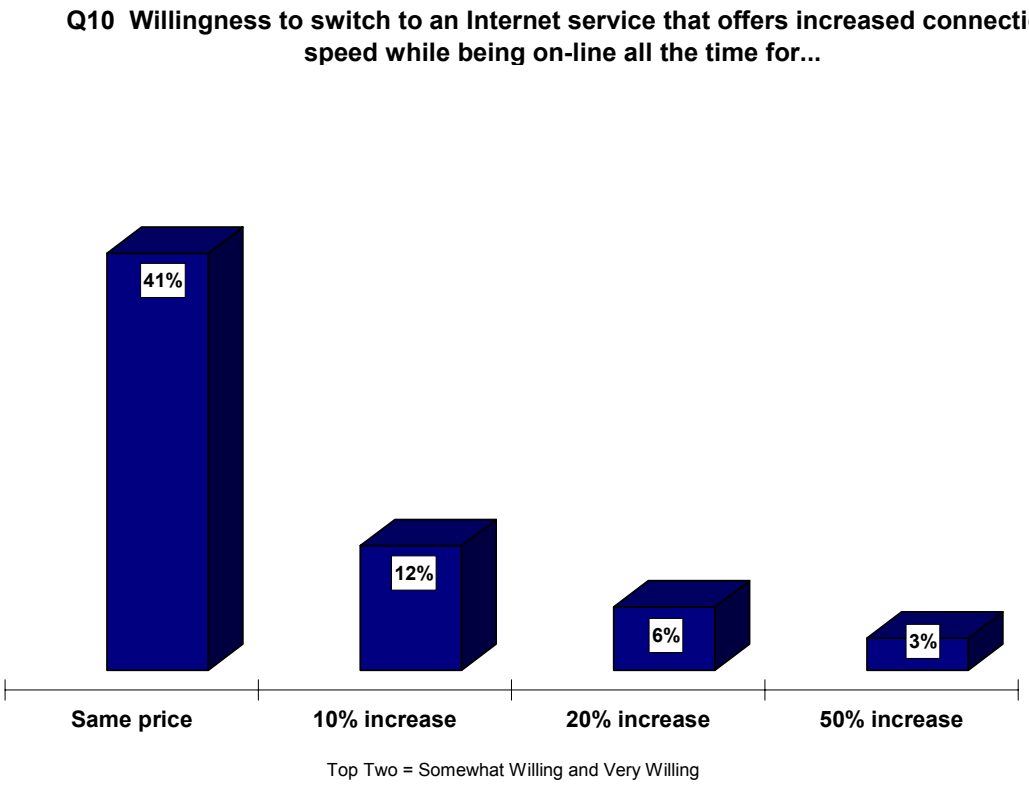


Figure 4.7: Propensity to Switch Internet Providers

As seen in Figure 4.8, 35 percent of those with Internet access would be interested in a wireless Internet service for the same price as they are paying, and 18 percent would be interested with a 10 percent price increase. Interestingly, no significant difference is seen between the wired and wireless options.

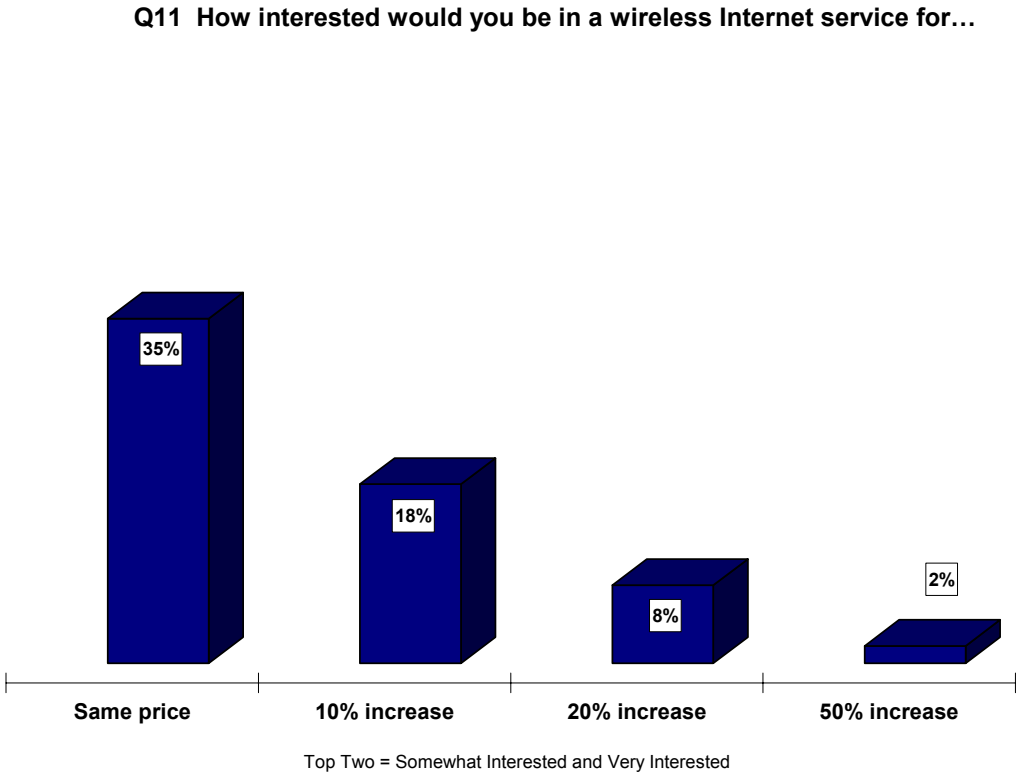


Figure 4.8: Propensity to Switch to Wireless

To show which features are most important, respondents were asked to rank the importance of Internet features on a scale of one to five. As indicated in Figure 4.9, price and connection speed were reported to be most important, with local office and parental control being rated as least important.

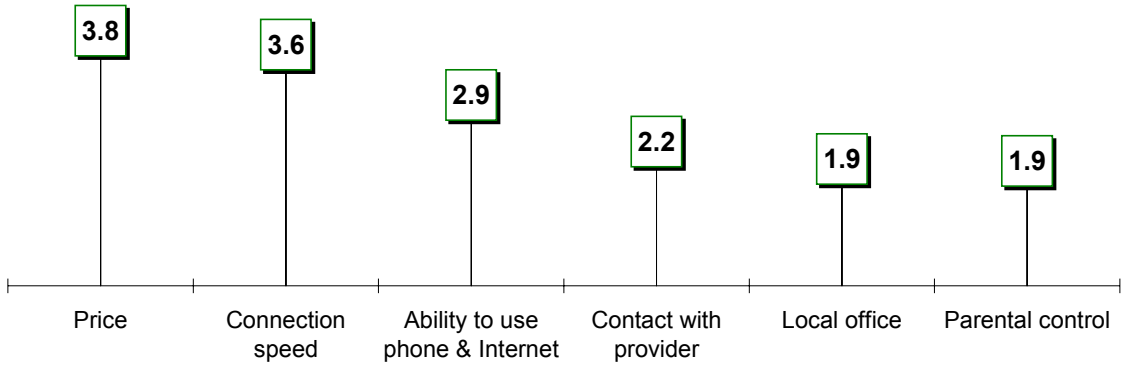


Figure 4.9: Importance of Features

To rate satisfaction, we used the mean score on a scale of one to five to look at satisfaction with the different categories of service. As indicated in Figure 4.10, respondents attributed the highest satisfaction among the categories to the ability to use the telephone and Internet at the same time, connection speed, and contact with provider, with a mean satisfaction score of 4.0. Given the strong penetration of high-speed alternatives among Kirkland residents, the survey results confirm that residents are satisfied with attributes unique to high-speed alternatives such as higher connection speed and the ability to use telephone and Internet at the same time.

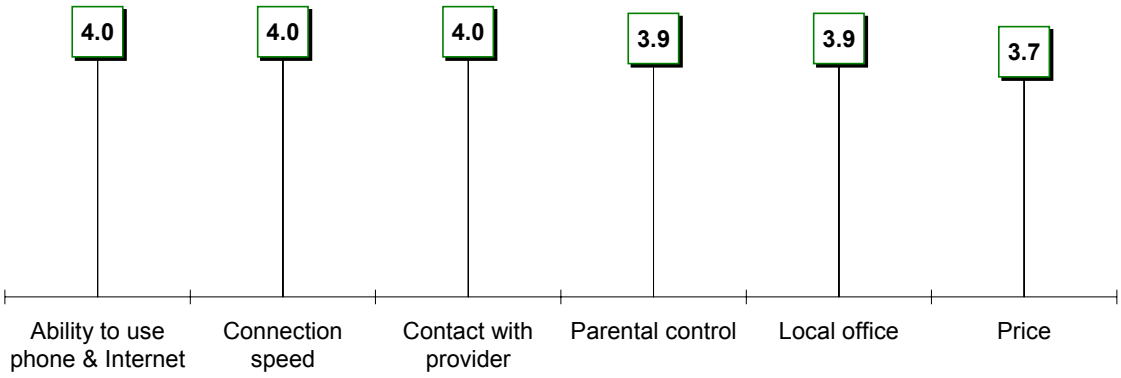


Figure 4.10: Satisfaction of Features

Table 4-1 compares survey respondents' satisfaction with Internet features with the stated importance of the features. Price paid for service and connection speed were the most important features. The level of satisfaction of price paid nearly matched the level of importance, while there is a significant difference for the connection speed.

Table 4-1: Internet Satisfaction vs. Features

	Mean Importance	Mean Satisfaction	GAP* < -- >	Significant?
Price Paid for Service (n=197, 201)	3.8	3.7	-0.1	N
Connection Speed (n=202,207)	3.6	4.0	0.4	Y
Ability to use Phone and Internet at the same time (n=196, 200)	2.9	4.0	1.1	Y
Ability to Contact Provider (n=194, 187)	2.2	4.0	1.8	Y
Local Office (n=187, 151)	1.9	3.9	2	Y
Parental Control (n=159, 130)	1.9	3.9	2	Y

* For statistically significant differences, p<.05.

Five of the features show a significant gap in satisfaction and importance (connection speed, ability to use phone and Internet at the same time, ability to contact provider, local office or representation, and parental control). In each case, however, **satisfaction was higher than importance, meaning that expectations are generally being met or exceeded.**

Demand

Users of high-speed Internet use more Internet products and services and have a higher demand for new products and services. This could be a result of an awareness of the benefits of high-speed Internet service or the lack thereof in the case of dial-up users. High-speed Internet users have educated themselves on the usefulness of certain Internet products and services and perceive a higher value for potential products. Dial-up users already have a use for the Internet, they are just unable to use it to its full potential. They might experience a difference using free or low-cost trials of high-speed service or encouraging public use of free high-speed connections.

An important segment of the residential population is made up of individuals conducting business from their homes. The connectivity needs of this group are very important because these users could benefit tremendously from a high-speed connection and, in turn, could benefit the local economy.

Given that 56 percent of Kirkland residents already use a high-speed alternative, education and awareness of benefits might only yield modest increases in the penetration of high-speed Internet alternatives. Figure 4.11 shows that most of the potential customers switching to a high-speed alternative are currently paying $51 or more per month for Internet access.

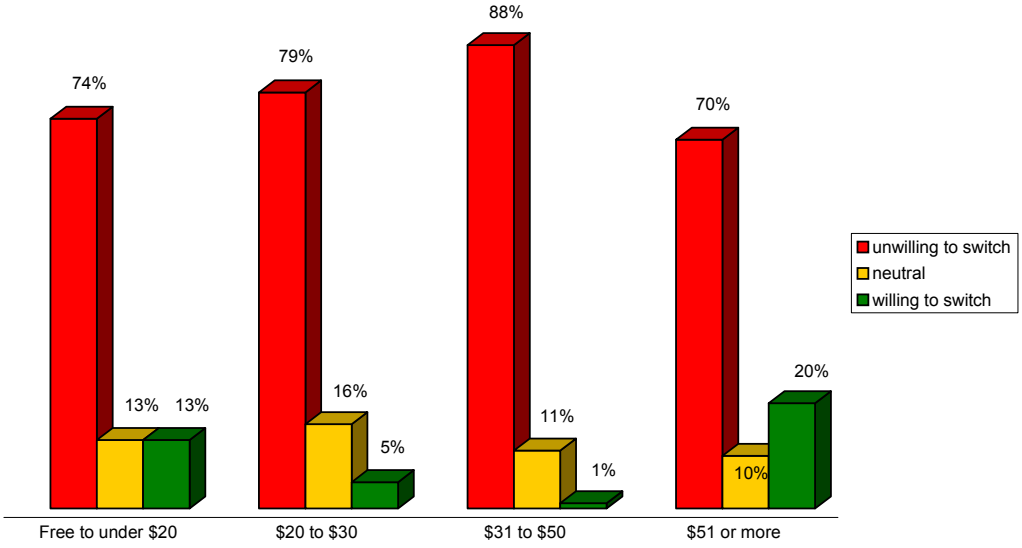


Figure 4.11: Willingness to Switch Internet Providers

Barriers

Most residents without Internet access indicated they do not have Internet service because they do not have a computer (61 percent). This lack of enabling hardware might be easily overcome by offering a low or no-cost PC option; for example, by offering used computers from local schools or municipal departments.

One quarter of individuals without Internet access say they have no need for access. These residents might be persuaded that they need access if they were more informed about how the Internet could benefit their lives or if they were given more reasons to use the Internet (for example, if more government services were available online).

Dial-up users may not be aware of the value they could receive from a high-speed connection. If they were given an opportunity to use a high-speed service, their perception of their needs, along with what they would pay for service might change. Exposing the public to the benefits and values of high-speed Internet service is key. One way to overcome this barrier is to put high-speed service in residents' hands (make the public more aware of free high-speed Internet sites such as libraries or schools).

Security

Seventeen (17) percent of Kirkland residents subscribe to a security or monitoring service. (Figure 4.12).

Q26 Subscribe to security or monitoring service

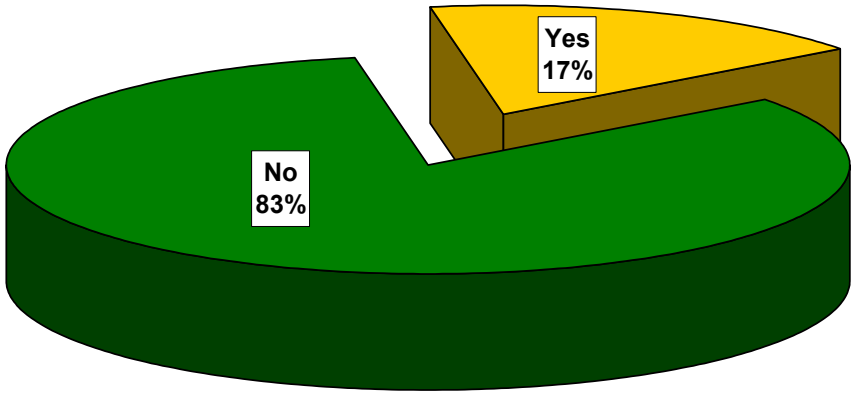


Figure 4.12: Use of Security Service

Among those who subscribe to security or monitoring services, almost half purchase a burglary detection service, followed by almost a third who purchase fire and smoke detection services. Less than one quarter of subscribers purchase carbon monoxide detection or medical monitoring services (Figure 4.13).

Q27 Security or monitoring service subscribers, which services do you subscribe

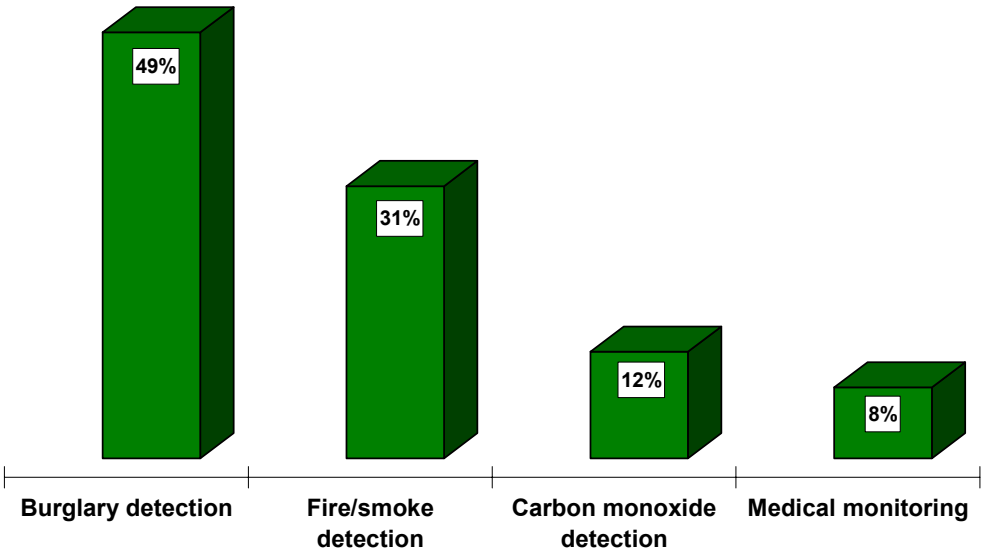


Figure 4.13: Security Service Subscription

The reasons for not subscribing to these services are shown in Figure 4.14. We found that almost half (41 percent of all households) indicated they feel there is no need to purchase these services. A third (27 percent of households) feel it is not worth the price.

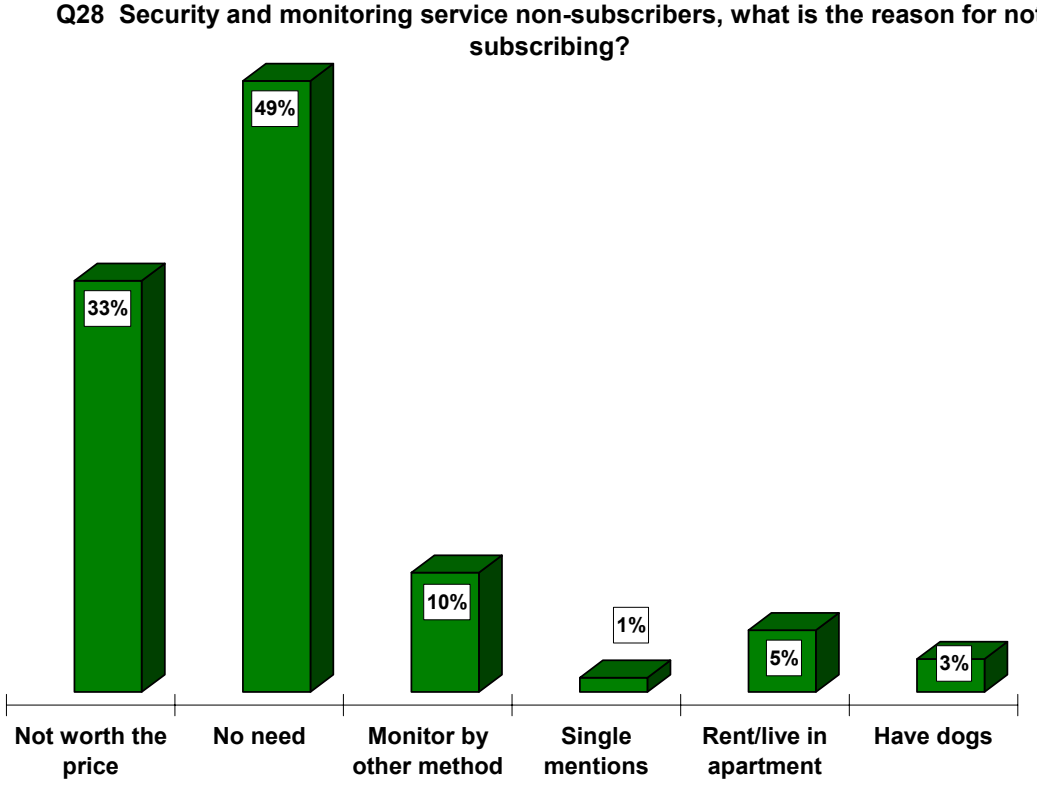


Figure 4.14: Reasons for Not Purchasing Security Services

Government Role

By combining responses that were either somewhat important or very important, we were able to calculate importance levels. According to survey responses, residents of Kirkland feel that having real-time emergency response (home linked to fire, police, and EMS) is the most important government service (86 percent). Less than a quarter of residents expressed that they believe local government television programming is important. Figure 4.15 shows, for each service, the percent of respondents who indicated it was either somewhat important or very important.

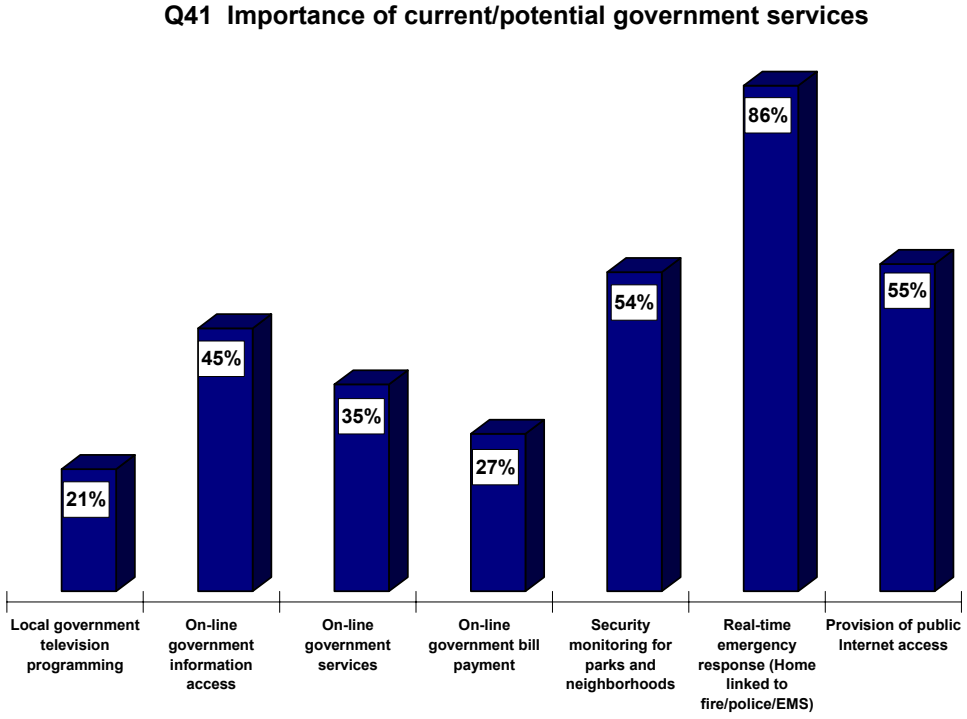


Figure 4.15: Importance of Government Services

The majority (68 percent) of Kirkland residents indicated the City of Kirkland should have **some** role to help ensure cable television, Internet, and telephone services are available and affordable. Fifty-nine (59) percent of those residents who think the City of Kirkland should have **some** role believe the **main** role for the City of Kirkland should be to make rules to promote competition among providers. This is more of a facilitating role than a physical role (see Figure 4.16).

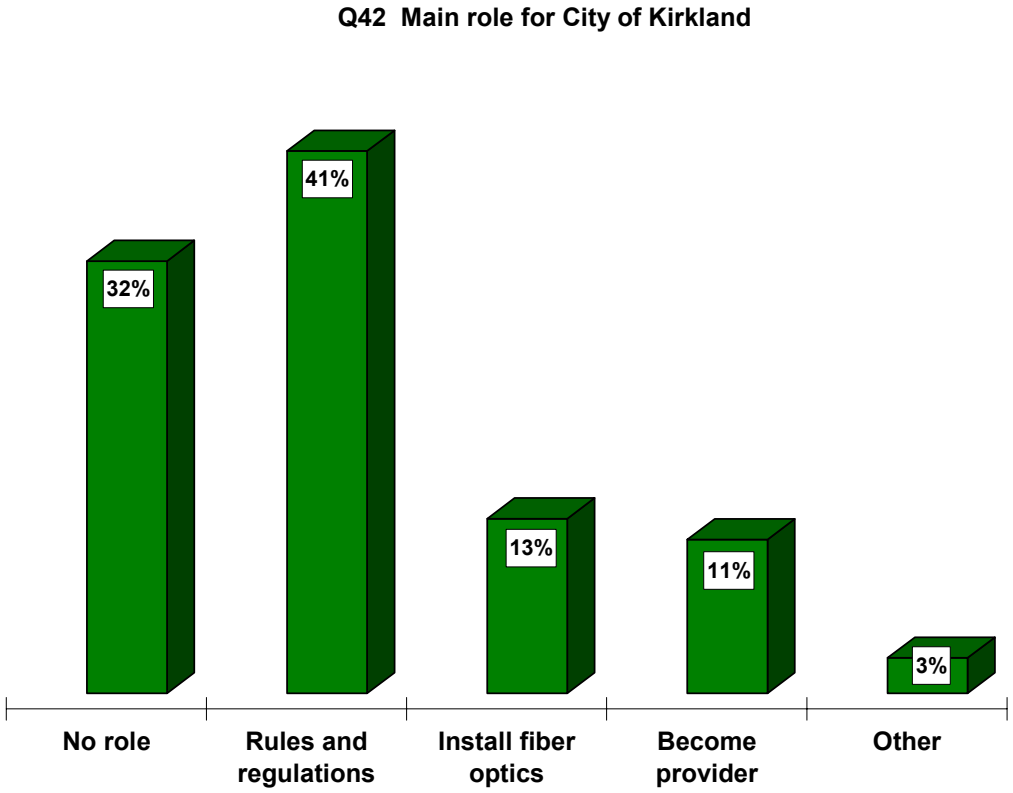


Figure 4.16: Best Role for the City

Figure 4.17 provides the responses to the role of government in facilitating information and services. A majority of residents indicated that the City of Kirkland should provide information (95 percent), partner with other government agencies (77 percent), provide faster response times (64 percent), and provide communications to non-profits (60 percent) to facilitate access to electronic information and services.

Q43 What do you think the role for the City of Kirkland should be to facilitate access to electronic information and services?

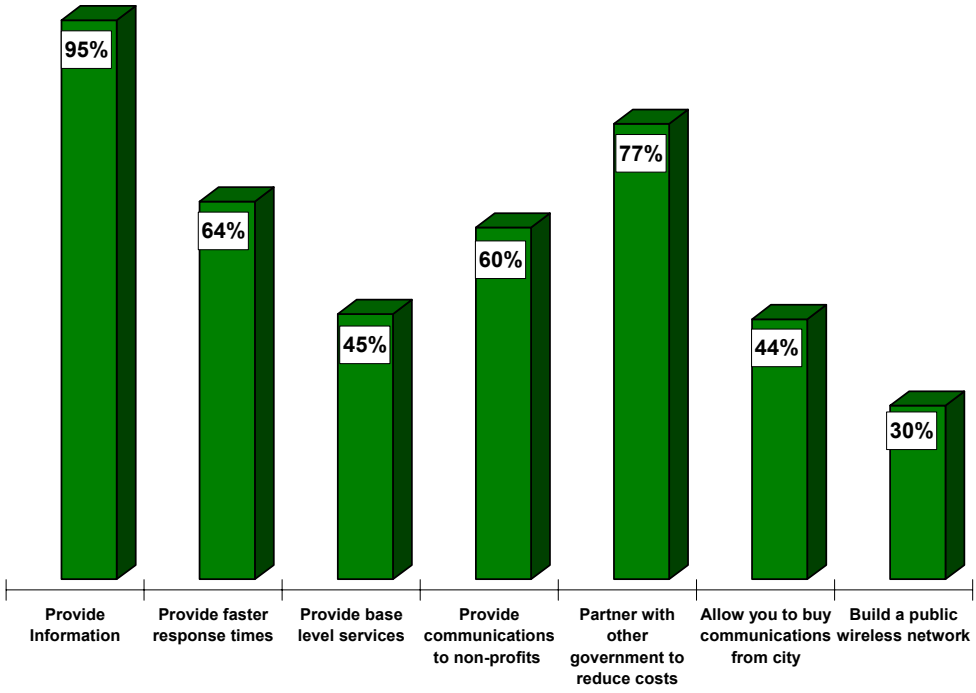


Figure 4.17: Role of Facilitating Information and Services

Residents of the City of Kirkland would be more willing to support a plan to offer a communications service if the business were operated with only subscriber revenues than if the business were operated with subscriber revenues and taxes (Figure 4.18).

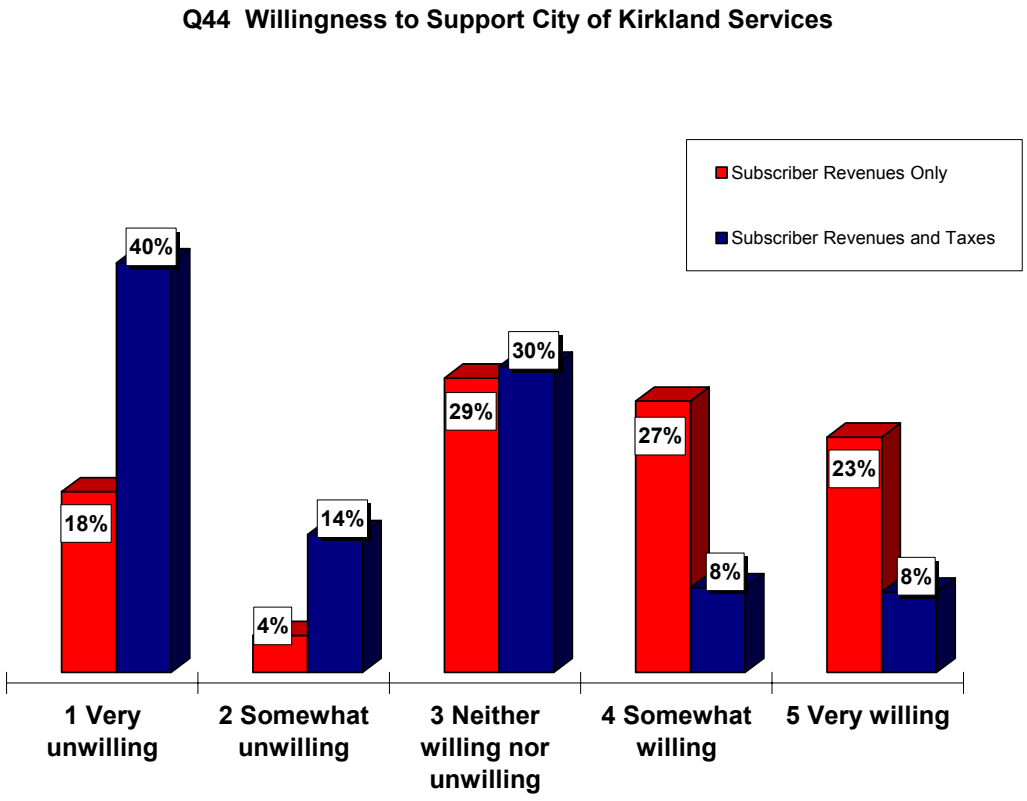


Figure 4.18: Willing to Support – Kirkland Services

Aggregate Residential Cross Tabs

Results of the survey responses can be further analyzed by comparing the responses to two or more questions (cross tabulations). Such analysis reveals the effects of age, income, and other factors on residents' use of the Internet or other services. To increase the statistical significance, we combined the Bellevue and Kirkland survey information. Exhibit VI provides cross tabulations for the individual cities, along with the complete set of responses for each question.

Figure 4.19 compares income level with Internet use. Figure 4.20 compares income to Internet monthly subscriber fees. Households with combined incomes between $100,000 and $149,999 had the highest percentage (98) of Internet access and on average paid $40 per month for their service. This group was followed very closely by combined household incomes between $50,000 and $74,999 and incomes above $150,000, for which 98 and 97 percent of those households had Internet access and on average paid $33 and $41 per month, respectively. Internet access is not only for the wealthy, however. Families with household incomes below $25,000 paid more on average for their Internet access than those families with incomes between $25,000 and $49,999.

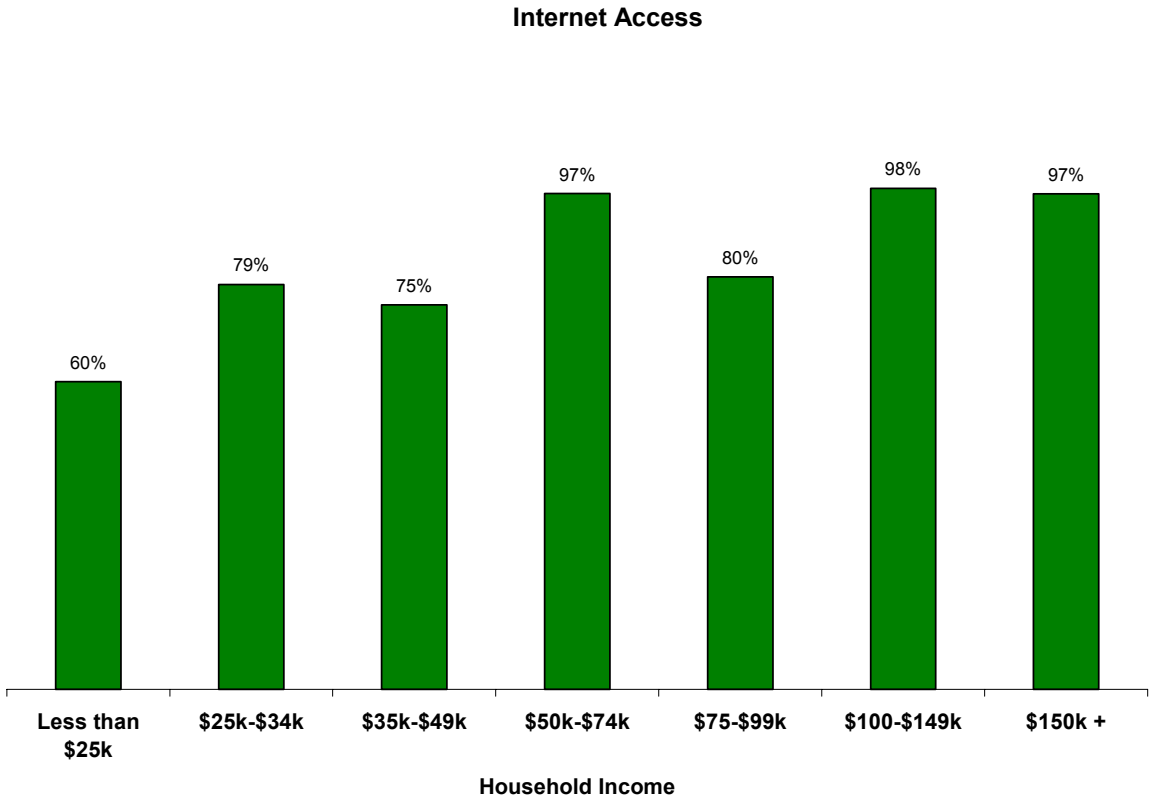


Figure 4.19: Income vs. Internet Access

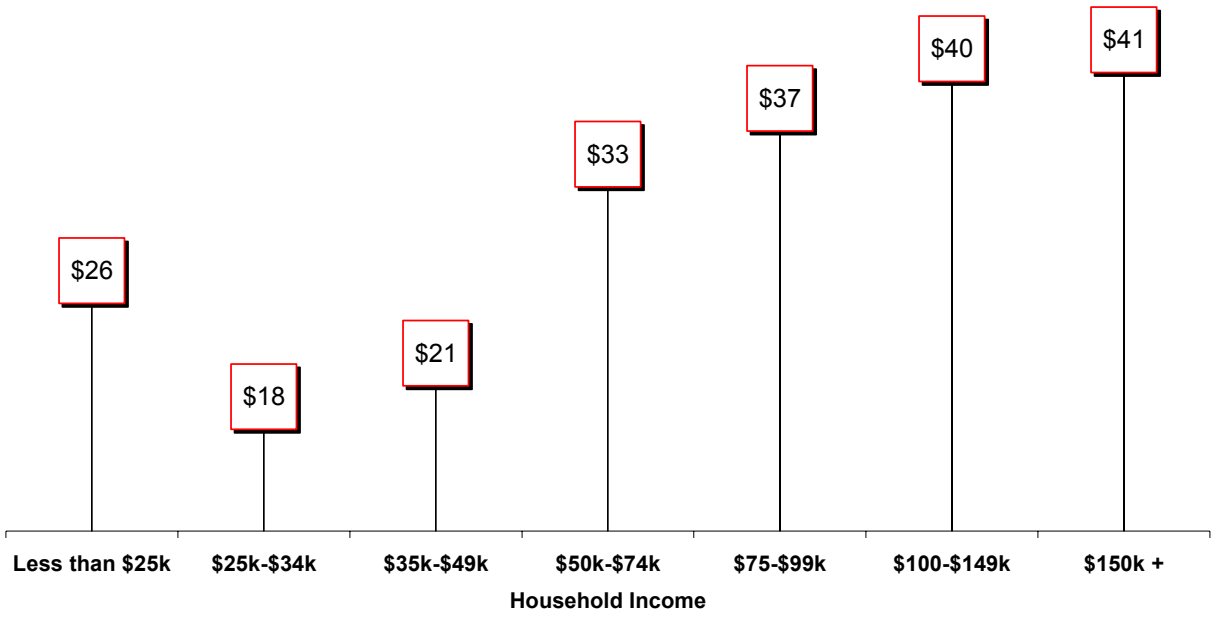


Figure 4.20: Income vs. Internet Monthly Subscriber Fee

Of those households with Internet access, a majority were more satisfied than dissatisfied with the price paid for Internet service (with the exception of households with incomes between $100,000 and $149,999, who were more dissatisfied than satisfied). Income did not seem to be a factor. This comparison is shown in Table 4-2.

As Tale 4-2 shows, households across all income levels with Internet access were more satisfied than dissatisfied with their Internet connection speed.

Over three quarters of all households across all income levels subscribe to either cable or satellite television. Satellite subscribers represent a larger percentage of the households with income above $100,000.

Table 4-2 also shows that households with combined incomes greater than $35,000 were more satisfied than dissatisfied with the price they paid for cable or satellite television service. Households with income below $35,000 were more dissatisfied than satisfied with the price they paid for cable or satellite television service. Cable and satellite television service are more price-sensitive than Internet service.

Table 4-2: Internet, Cable and Security Monitoring Use and Satisfaction by Income Level

	Below $25,000	$25,000-$34,999	$35,000-$49,999	$50,000-$74,999	$75,000-$99,999	$100,000-$149,999	Above $150,000
Internet price satisfaction	100%	50%	47%	60%	72%	43%	48%
Internet speed of connection satisfaction	100%	43%	39%	81%	65%	56%	62%
Subscribe to cable or satellite	80%	84%	75%	75%	85%	93%	97%
Cable price satisfaction	40%	39%	42%	53%	40%	50%	45%
Subscribe to security monitoring	20%	11%	17%	10%	7%	14%	27%

Table 4-3 shows that the income level most concerned with online government information access were the households with incomes between $75,000 and $99,999.

The income level most willing to support the city if it were to offer a communication service operated with subscriber revenues only were the households with incomes between $50,000 and $74,999. This relationship is shown in Table 4-3.

Table 4-3: Importance of Online Government Information Access and Willingness to Support City Communication with Subscriber Revenues by Income

	Below $25,000	$25,000-$34,999	$35,000-$49,999	$50,000-$74,999	$75,000-$99,999	$100,000-$149,999	Above $150,000
Importance of online government information access (1 = Very Unimportant; 5 = Very Important)	3.1	3.1	2.9	3.5	3.8	3.0	3.4
Willingness to support communication with subscriber revenue (1 = Very Unwilling; 5 = Very Willing)	3.0	3.3	3.6	3.8	2.4	3.3	3.5

Figure 4.21 shows the relationship between the role residents felt the city should play and mean household income. Higher-income residents expressed that the city should play a more active role.

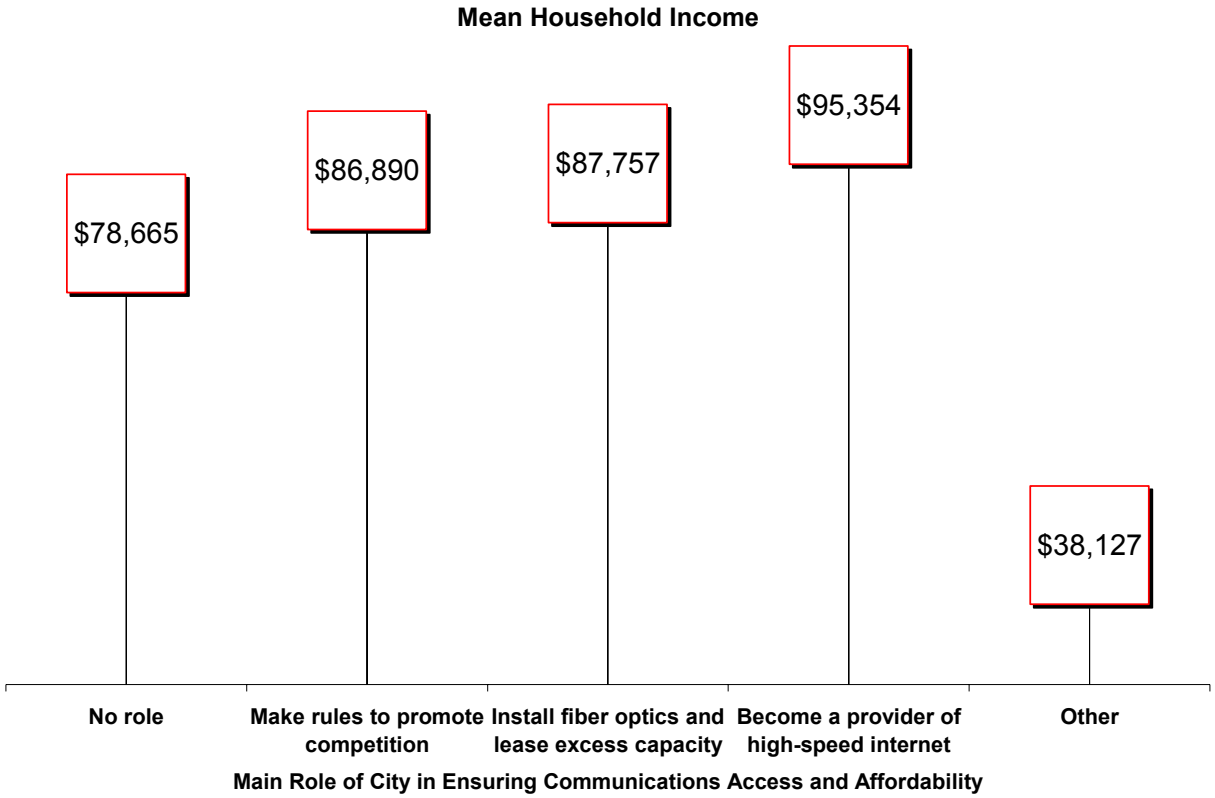


Figure 4.21: Preferred Roles of Government: Mean Household Income of Respondents Who Chose Each Role

The difference in Internet access costs between high-speed and low-speed is significant. As seen in Figure 4.22, the mean amount paid per month for high-speed Internet service is $40[31], which is a little over double the amount paid per month for low-speed ($16)[32].

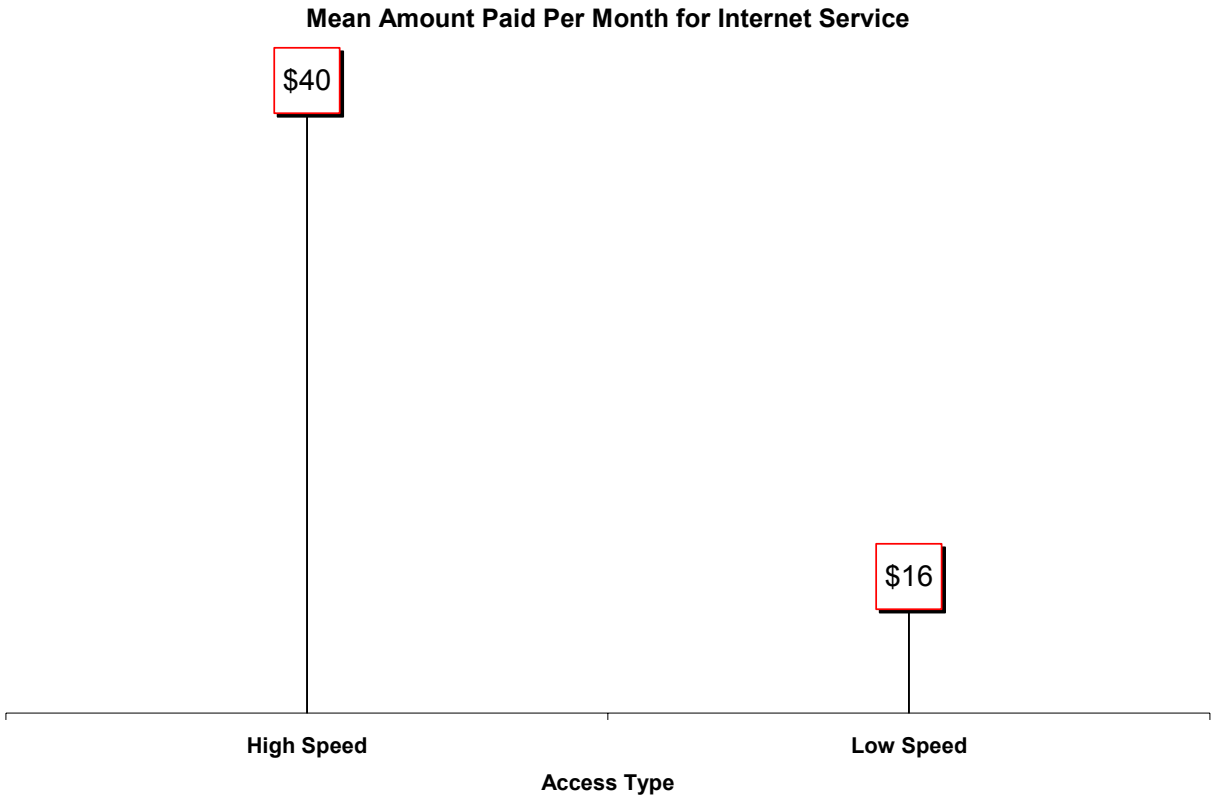


Figure 4.22: Internet Access Cost

[31] Combined Average: In Bellevue, the average is $38 per month. In Kirkland, the average is $41 per month.

[32] Combined Average: In Bellevue, the average is $19 per month. In Kirkland, the average is $15 per month.

Both high-speed and low-speed Internet users are more satisfied than dissatisfied with the price they paid for Internet service and with their Internet connection speed, as shown in Figure 4.23. Note the magnitude of difference between speed and price (i.e., high-speed users are not significantly more dissatisfied with price but are much happier with speed).

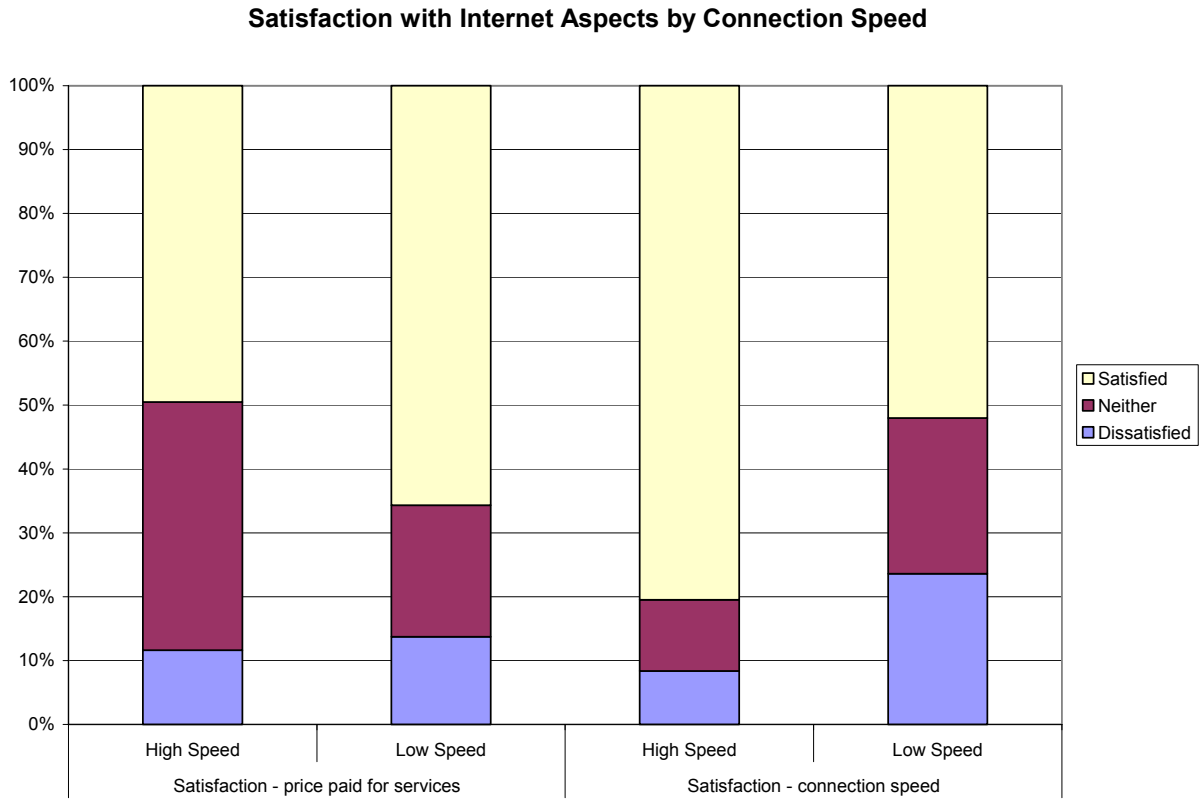


Figure 4.23: Satisfaction with Internet Aspects by Connection Speed

The mean household income for users of high-speed Internet is $93,798, and the mean income for low-speed users is $63,537.

As illustrated in Figure 4.24, both high-speed and low-speed Internet users believe the most important government service is real-time emergency response.

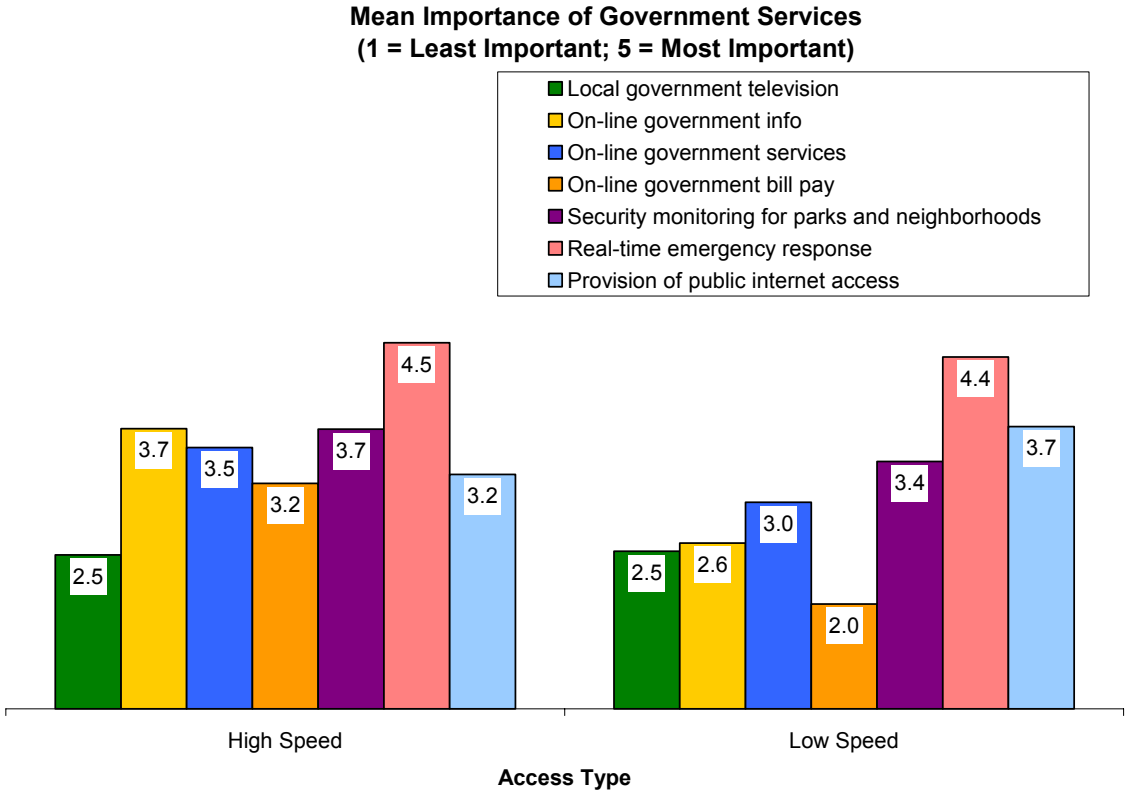


Figure 4.24: Access Type vs. Government Service

Among both high-speed and low-speed Internet users, the largest percentages in each group expressed that the city should make rules to promote competition among providers in order to help ensure that cable television, Internet, and telephone services are available and affordable (Figure 4.25). Note that the margin between "promoting competition" and "no role" was much smaller among low-speed users. In other words, low-speed users may be less supportive of government intervention than high-speed users.

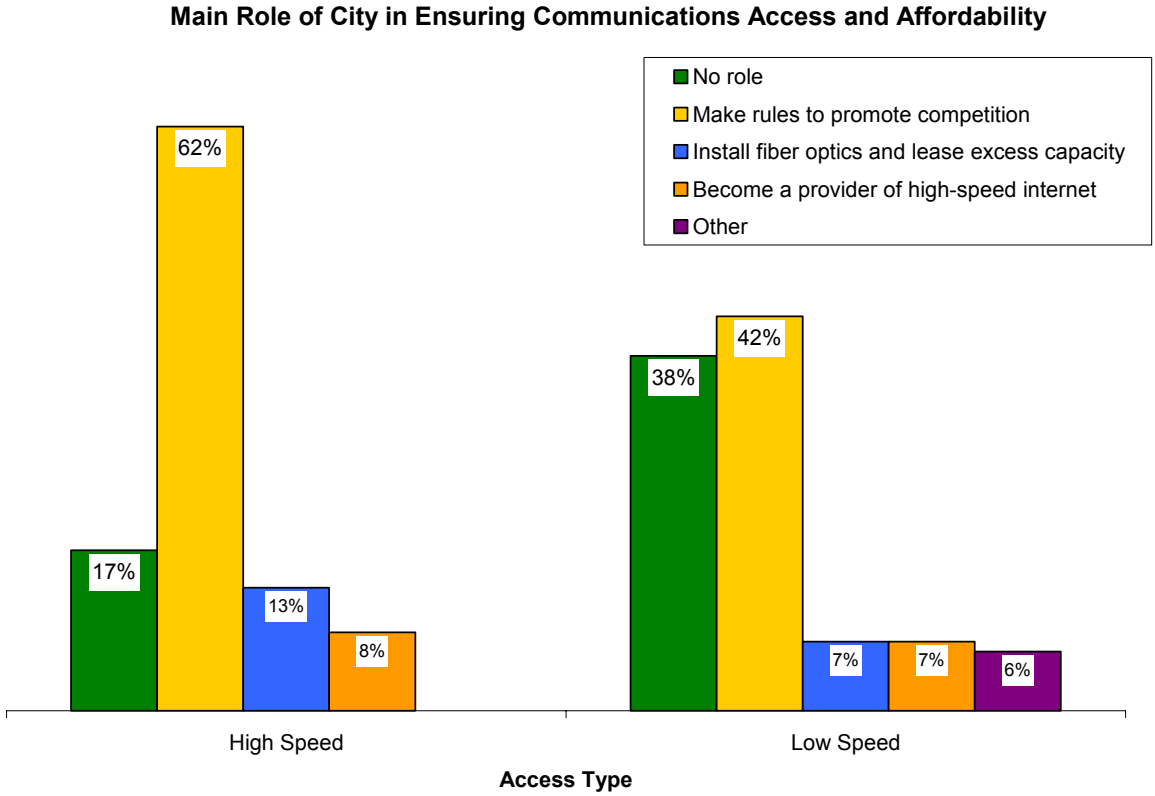


Figure 4.25: Access Type vs. City Role

Using the mean willingness to support the city if they were to offer a communication service operated by only subscriber revenues, both high-speed and low-speed Internet users were in the "neither willing nor unwilling" to "somewhat willing" range. If the city were to offer a communication service operated by subscriber revenues and taxes, both users were in the "somewhat unwilling" range. These relationships are shown in Table 4-4.

Table 4-4: Mean Willingness to Support City Communications Using Subscriber Revenues Only or Subscriber Revenues and Taxes, by Connection Speed (1 = Very Unwilling; 5 = Very Willing)

	Revenues Only	Revenues and Taxes
High-speed	3.4	2.4
Low-speed	3.1	1.9

Clearly, residents have strong concerns about using tax dollars to support a retail service.

4.3 Business Market Assessment

Kirkland Business Needs Assessment

In this section, we provide an overview of the business survey. A complete analysis is presented in Exhibit VI-C. The findings that follow are based on a telephone survey conducted in February and March 2004. The survey collected 250 responses from Kirkland businesses. The confidence interval for 250 responses at the 95 percent confidence level is ±5.9 percent. In other words, 19 times out of 20, the opinions expressed by the survey results accurately reflect the opinions of the entire population within ±5.9 percent.

Figure 4.26 below depicts where connectivity (voice, video, data) decisions are made for businesses in Kirkland. Eighty-nine (89) percent of Kirkland businesses make their connectivity decisions locally.

Q5 Where are connectivity decisions made?

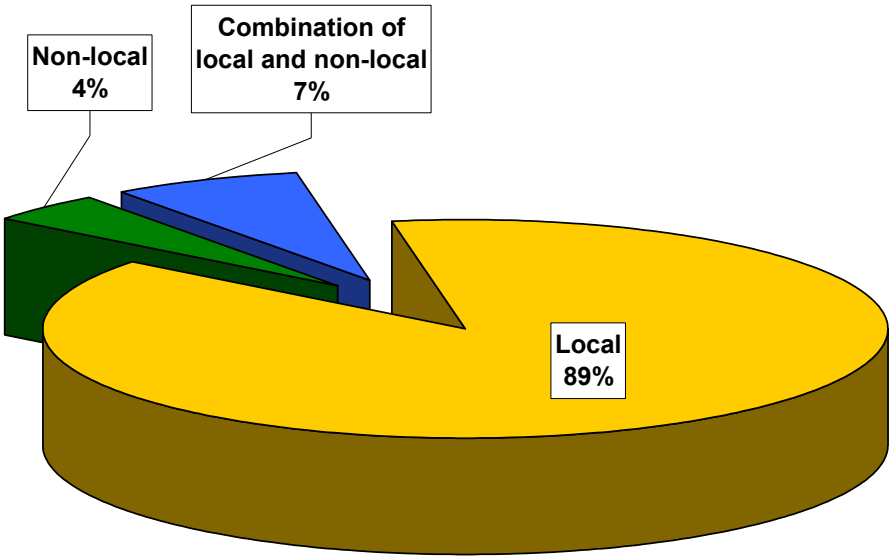


Figure 4.26: Connectivity Decisions

Just over half of the businesses surveyed indicated that a single provider would best supply their connectivity (voice, video, data) service needs.

Less than a quarter (15 percent) of the businesses responded that they exchange electronic data with locations within Kirkland, as shown in Figure 4.27. Among the businesses that exchange electronic data with locations within Kirkland, almost half (44 percent) indicated that they exchange with four or more locations. Businesses that exchange data within Kirkland might realize performance and cost benefits if given access to a municipal area network (MAN).

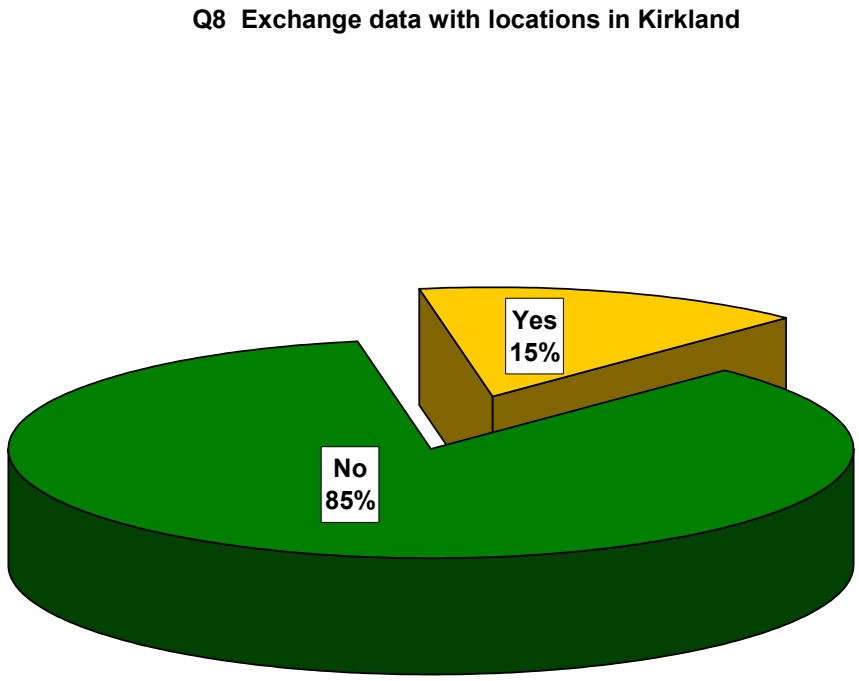


Figure 4.27: Data Exchange Within Kirkland

About a third of the businesses said they exchange electronic data with locations outside of Kirkland, as shown in Figure 4.28. Among the businesses that exchange data with locations outside of Kirkland, over half indicated that they exchange with only one location. Of the businesses that exchange data outside of Kirkland, 41 percent exchange with locations outside of Washington, 34 percent exchange with Seattle and 27 percent each exchange with Bellevue, and 16 percent exchange data with Redmond and all over Washington. Results are shown in Figure 4.29.

Q10 Exchange data with locations outside Kirkland

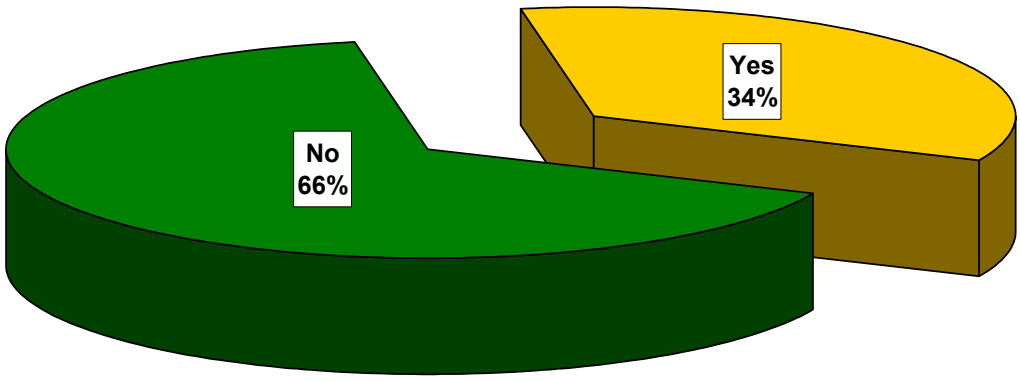
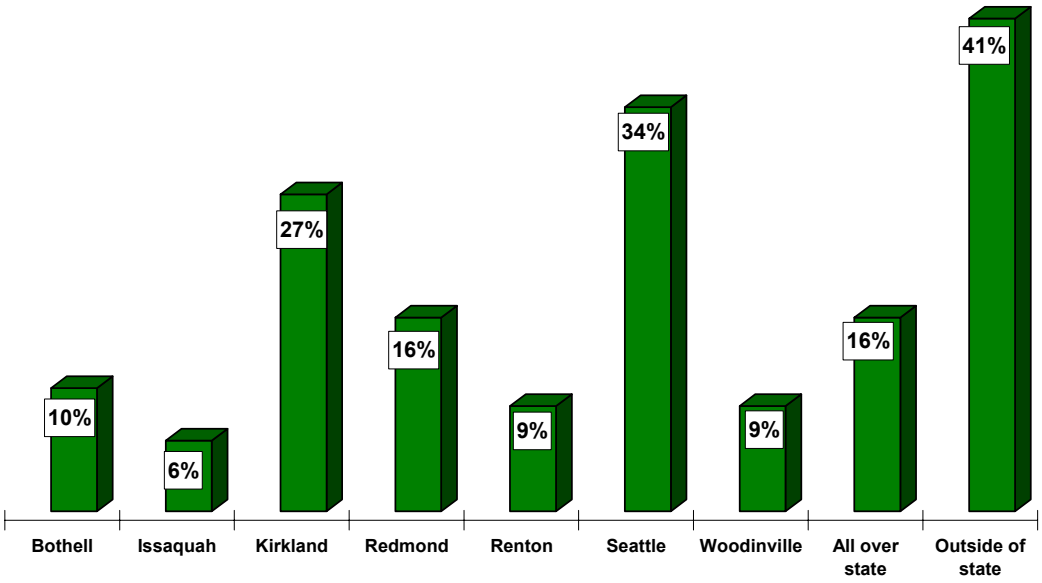


Figure 4.28: Locations Outside Kirkland

Q12 For those who exchange electronic data outside of Bellevue, which locations do you exchange with?



All other responses were below 5% (Kenmore, Outside of country, Clyde Hill, Mercer Island, Medina, Newcastle, Sammamish, and None)

Figure 4.29: Data Exchange Locations Outside Kirkland

Most businesses (61 percent) have between one and four computers at the location surveyed.

Eighty-one (81) percent of businesses have Internet access at the location surveyed, as seen in Figure 4.30. This percentage is consistent with the national average.

Q14 Internet access at this location

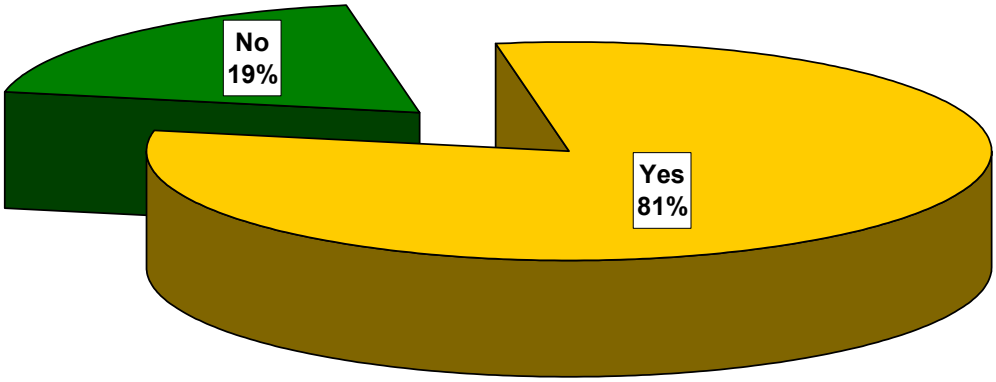


Figure 4.30: Internet Access

Of the businesses without Internet access, 20 percent plan to obtain Internet access in the next year, so we can expect to see an additional four percent of businesses acquiring Internet access over the next year. Most potential customers are already on line (Figure 4.31), so, Internet providers need to increase revenues by either shifting users to a high-end service or increasing ancillary services to expand their business.

Q15 Of those without Internet access, do you plan to obtain Internet access in the next year?

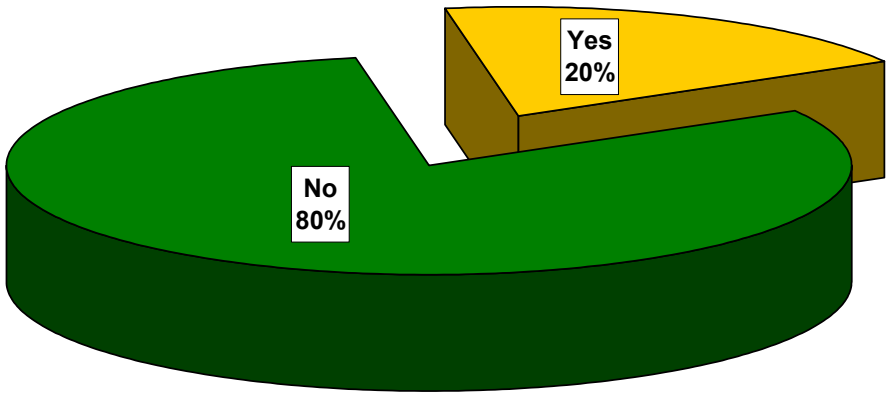


Figure 4.31: Access in Next Year of Those Without Internet Access

Only five percent of businesses with Internet access are using a low-speed connection (dial-up telephone). DSL is the most widely used high-speed connection; half of all businesses use this connection, as seen in Figure 4.32. The use of DSL in Kirkland is higher than that in Bellevue (by 19 percent). The use of satellite in Kirkland is about half of that in Bellevue (13 percent). This may be due to the different types of businesses located in Kirkland. Satellite is popular with many nationally-based organizations that use satellite for Internet and data use. This allows the organization to avoid any local loop or local provider issues.

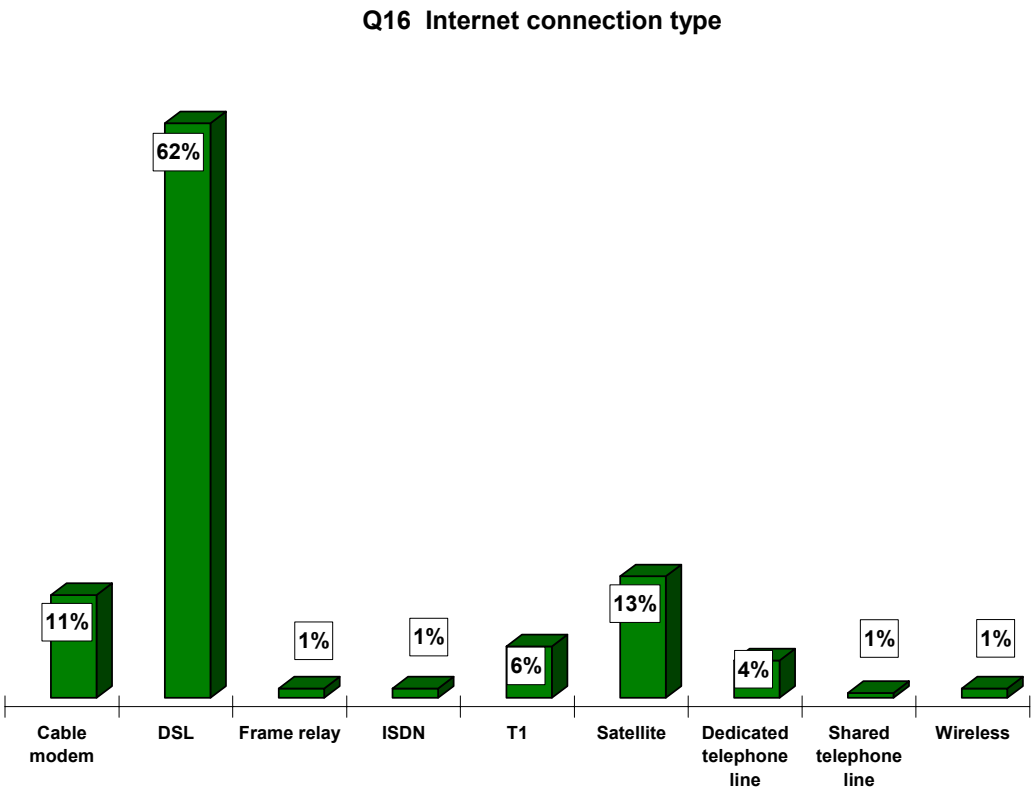


Figure 4.32: Connection Type

Almost one-third of businesses with Internet access are either somewhat interested or very interested in using a wireless Internet service. Figure 4.33 shows these results.

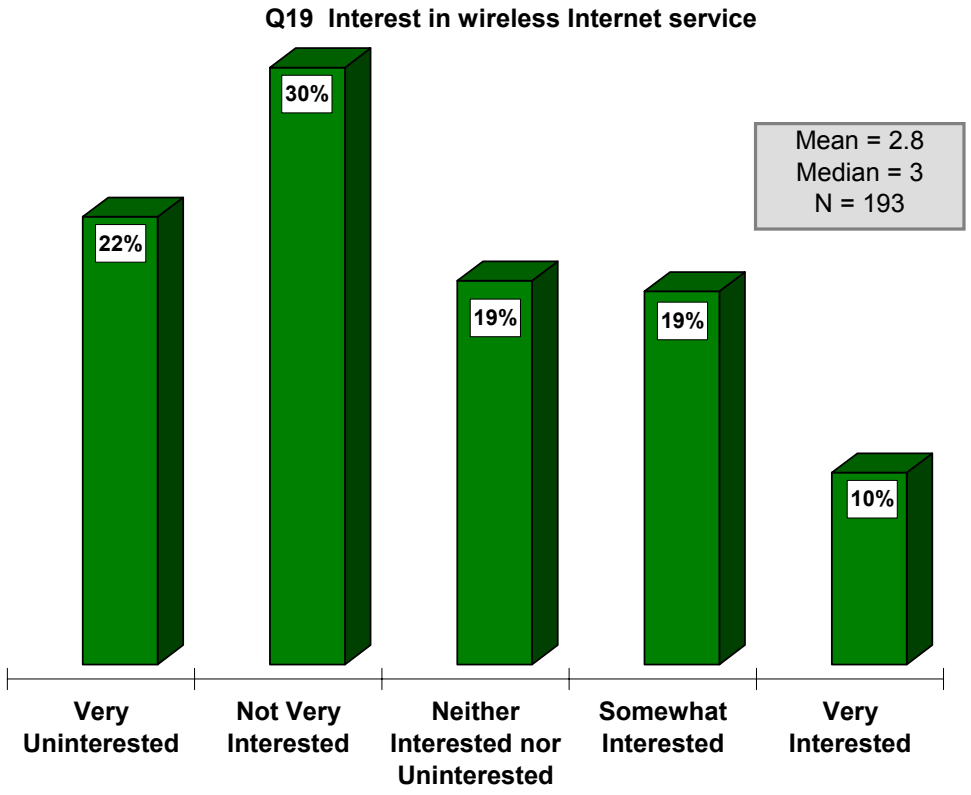


Figure 4.33: Interest in Wireless Internet Service

Figure 4.34 shows that almost two-thirds of businesses with Internet access are somewhat concerned or very concerned with the security of their own wireless Internet service. However, as seen in Figure 4.34 only 20 percent of businesses with Internet access are somewhat concerned or very concerned with the security of using a public wireless Internet service. This difference raises a question: Why are businesses concerned with private Internet access but not public access? We speculate that the difference is in their projections of the types of transactions they will conduct access over a public network versus those they will conduct over a private network for their business transactions.

Q20&Q21 Concern with security of private and public wireless Internet

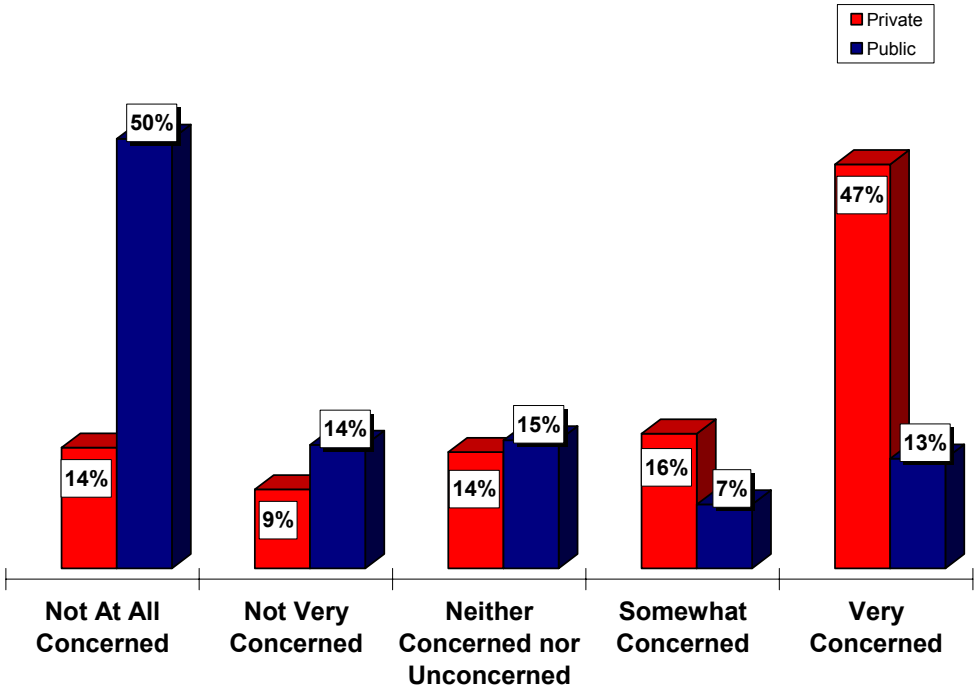


Figure 4.34: Concern with Security

Businesses with Internet access are most satisfied with the elimination of the need to dial-up in order to connect (89 percent) and reliability (system is “up”; 82 percent) as characteristics of their current Internet access. They are least satisfied with the price of the services (65 percent) and their choice of providers (competition) (70 percent) as shown in Figure 4.35. For a competitive offering, increasing the value proposition will be critical to attract customers and maintain contribution margins sufficient to cover debt service.

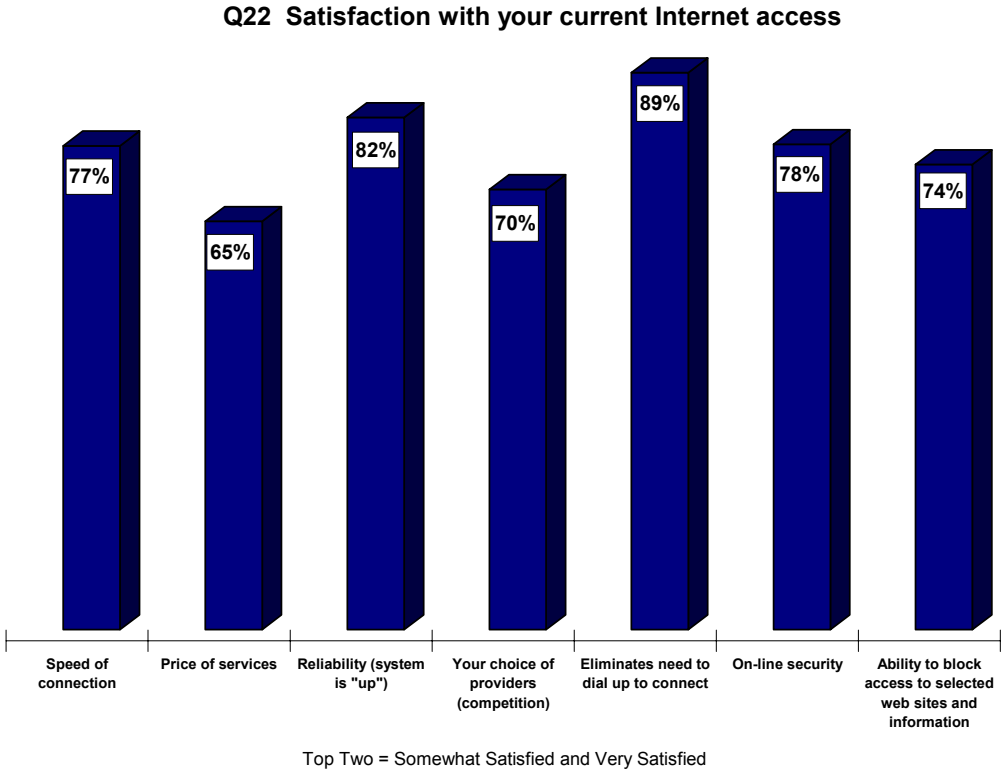


Figure 4.35: Satisfaction With Current Internet Access

Combining the top two answers (somewhat important and very important) can lead us to an importance level. **Seventy-eight (78) percent of businesses with Internet access feel that Internet access is important to their business' ability to achieve their strategic goals.** A little more than half of the businesses feel that Internet access is important to their business' facility location decisions. Seventy-six (76) percent of businesses said that Internet access is important to their business' ability to remain competitive. These are show in Table 4-5.

Table 4-5: Importance of Internet Access to Your Business

Importance of the Internet in—	Very Unimportant	Somewhat Unimportant	Neither Important nor Unimportant	Somewhat Important	Very Important
Ability to achieve strategic goals	4%	8%	9%	8%	70%
Facility location decisions	21%	9%	13%	14%	44%
Ability to remain competitive	10%	9%	6%	15%	61%

Figure 4.36 shows that over half of the businesses with Internet access would be willing to switch to an Internet service that offers an increased connection speed that makes online access available all the time for the same price as they are currently paying.

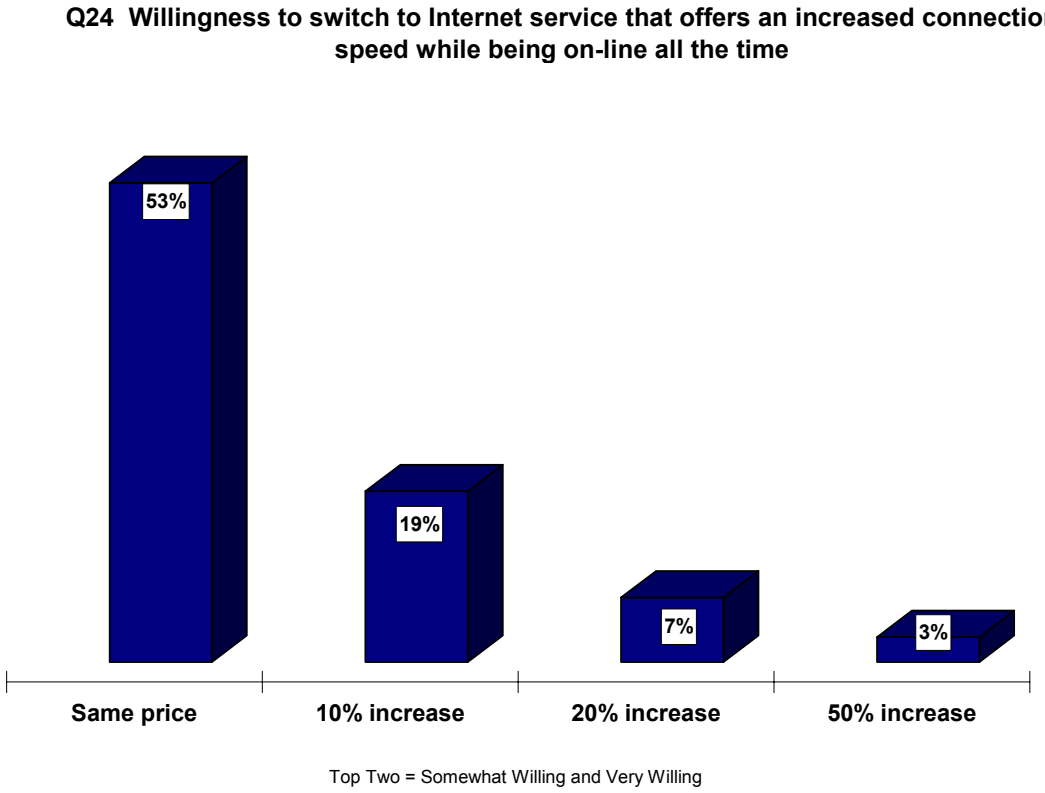


Figure 4.36: Willingness to Switch Internet Providers

Price is a significant factor when deciding whether to purchase Internet service. For example, over one-third would be willing to purchase a service that offers at least 1,544 Kbps downstream and upstream for up to $49 per month. Only 19 percent would be willing to pay between $50 and $99 per month. All results are presented in Figure 4.37.

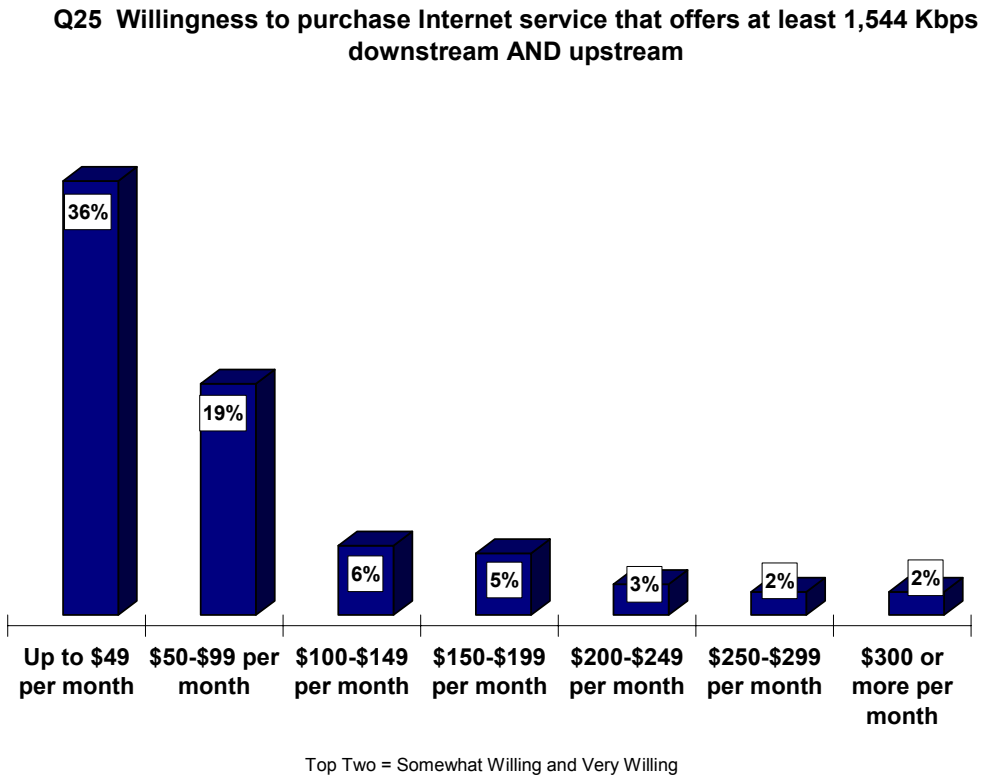


Figure 4.37: Willingness to Purchase Higher Speed Internet Services

Although eight of ten businesses indicate that Internet access is important to their strategic goals, only six percent are willing to pay $100 or more per month for a high-end service (T-1 or greater).

Two-thirds of businesses are not interested in a fiber optic interconnection within Kirkland. Fourteen (14) percent would be interested and 7 percent might be interested. Thirteen (13) percent of businesses are unfamiliar with the technology. Results are shown in Figure 4.38.

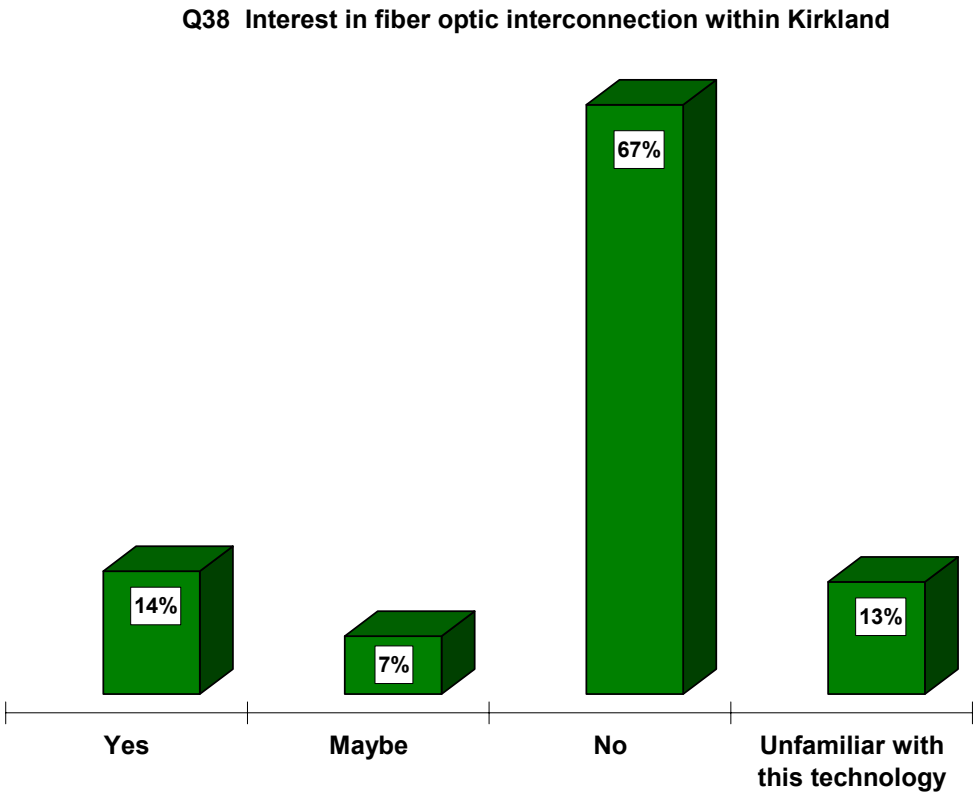


Figure 4.38: Fiber Optic Interconnection in Kirkland

Nine (9) percent of businesses are interested in a fiber interconnection with other communities in the area. Among those businesses interested in an interconnection, the communities they are interested in are Bellevue (68 percent), Seattle (60 percent), Woodinville (56 percent), Redmond (52 percent), and Renton (44 percent). Results are shown in Figure 4.39 and 4.40.

Q39 Interest in fiber optic interconnection with other communities

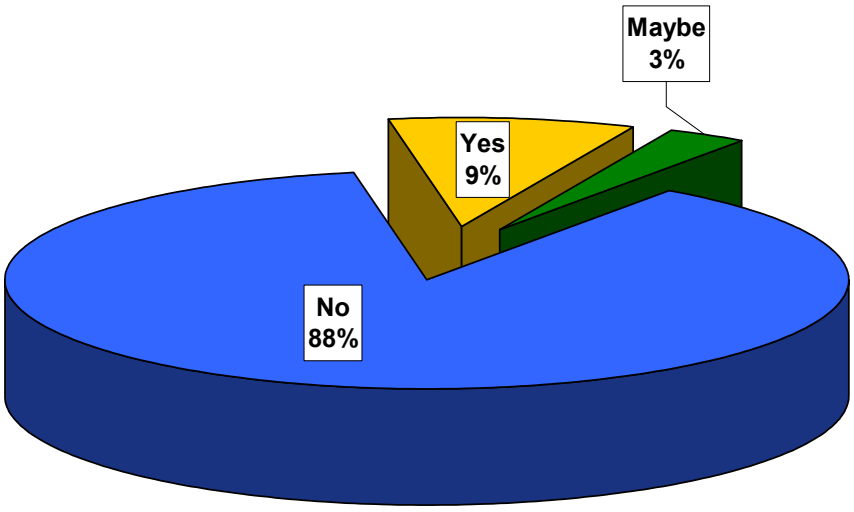
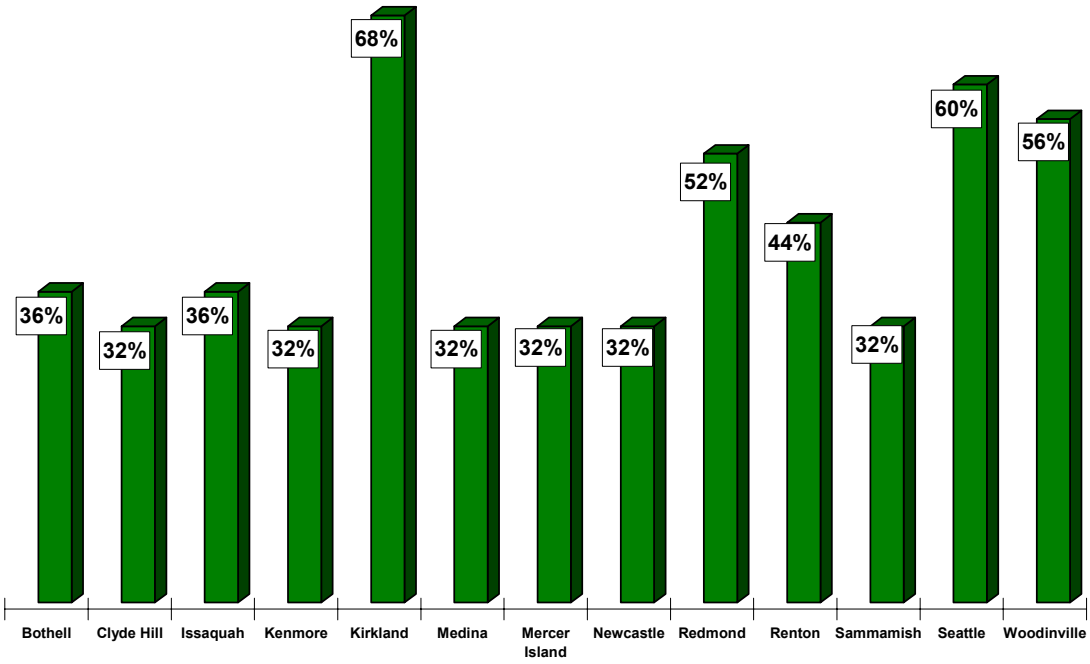


Figure 4.39: Fiber Optic Interconnection with Other Communities

Q40 For those who are interested in a firber interconnection, which communities are you interested in?



All other reponses were below 10% (Other and None)

Figure 4.40: Fiber Optic Interconnection – Communities of Interest

Twenty-six (26) percent of businesses subscribe to a security or monitoring service for their business as shown in Figure 4.41. For those businesses that subscribe to these services, over three quarters purchase intrusion detection and control, over half purchase fire and life safety, and less than one quarter purchase video surveillance (Figure 4.42). For those businesses that do not subscribe to these services, most (81 percent) feel there is no need for these services.

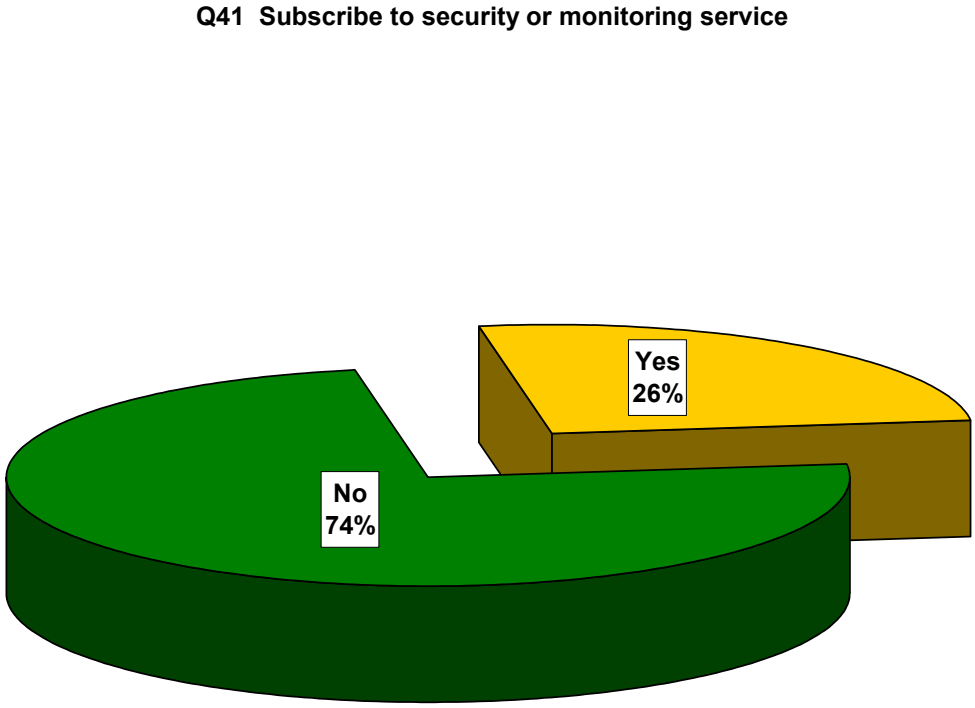


Figure 4.41: Subscribe to Security or Monitoring

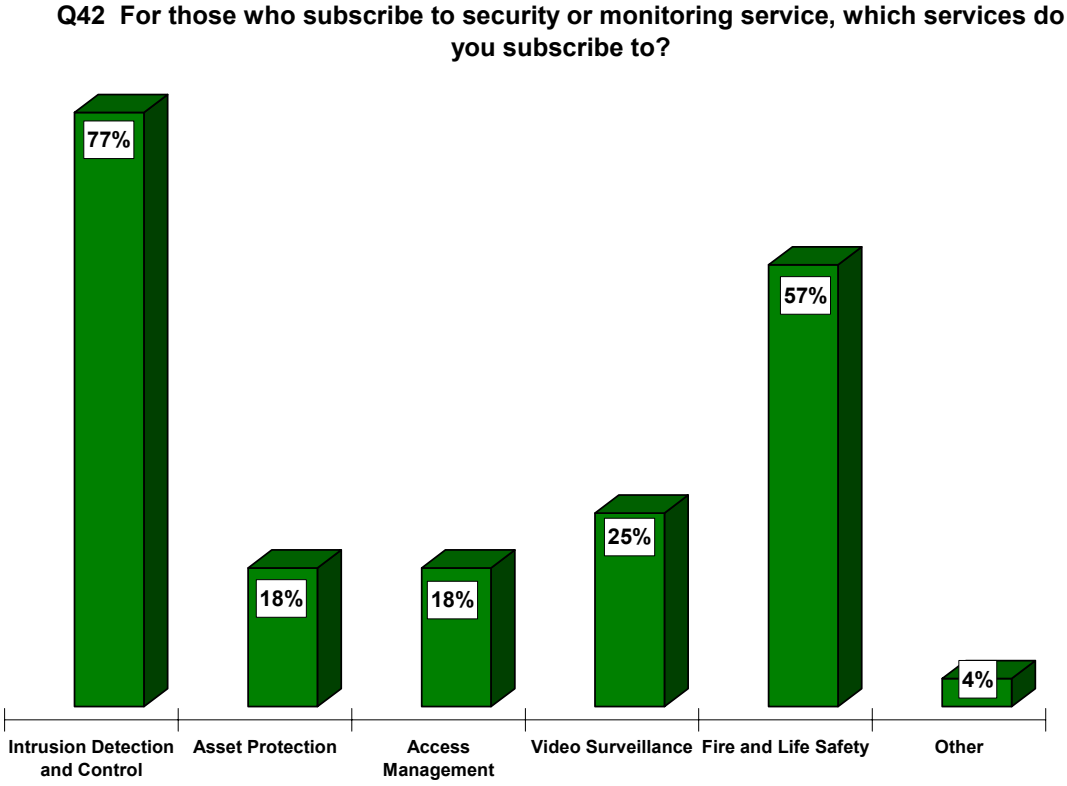


Figure 4.42: Subscription to Security or Monitoring Services

As shown in Figure 4.43, 65 percent of businesses think that the City of Kirkland should have **some** role to help ensure high-speed Internet access is available and affordable. The top two roles that the majority of businesses (37 percent and 35 percent) felt the City of Kirkland should have is to make rules to promote competition among providers and no role respectively.

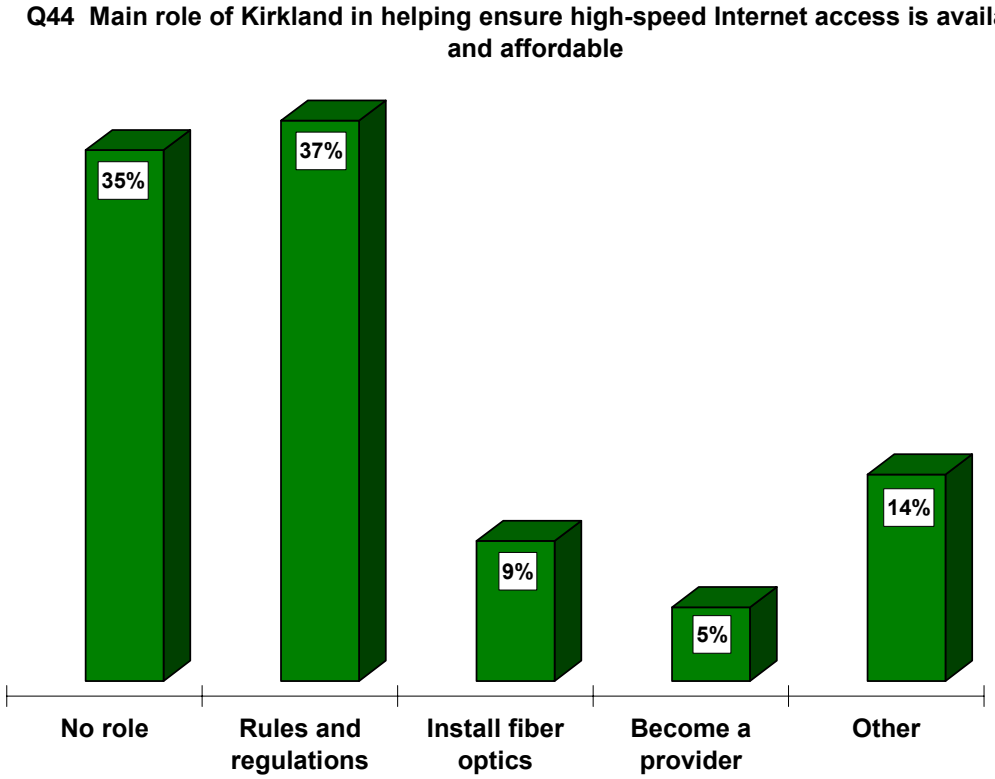


Figure 4.43: Main Role of Kirkland in Ensuring Access

The top choices for Kirkland's role in facilitating access to electronic information and services are to provide faster response times (64 percent), provide information (62 percent), and partner with other government agencies (60 percent). The bottom choice was for Kirkland to have no role in private business (Figure 4.44).

Q45 What should the role of the City of Kirkland be to facilitate access to electronic information and services?

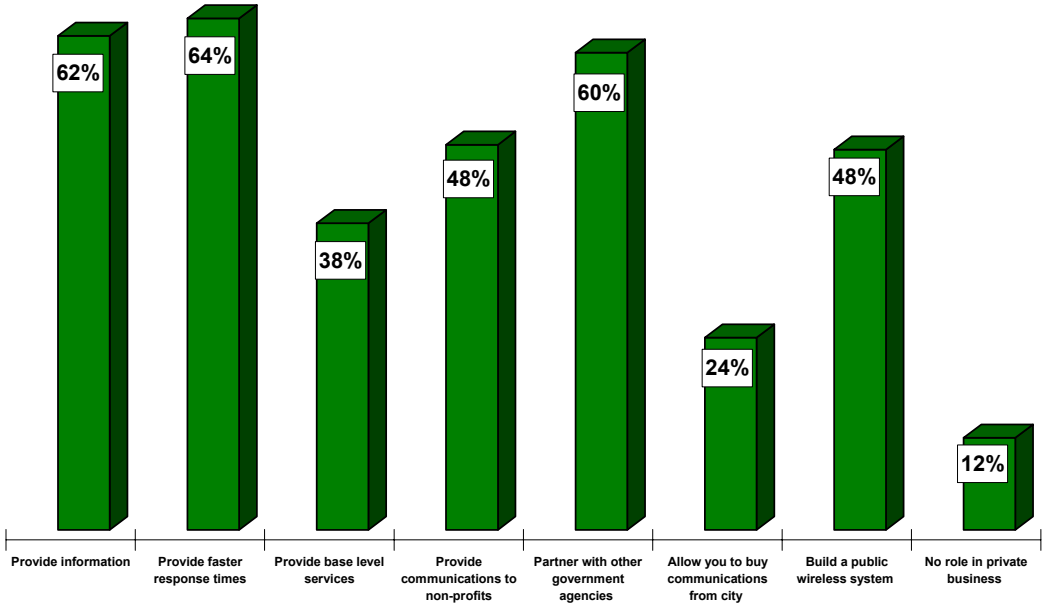


Figure 4.44: Role of Kirkland in Facilitating Access

If the City of Kirkland offered a communications service, businesses would be more willing to support this plan provided the business were operated with only subscriber revenues rather than subscriber revenues and taxes. Results are shown in Figures 4.45.

Q46 Willingness to support the City of Kirkland with a communications service from subscriber revenues only or subscriber revenues and taxes

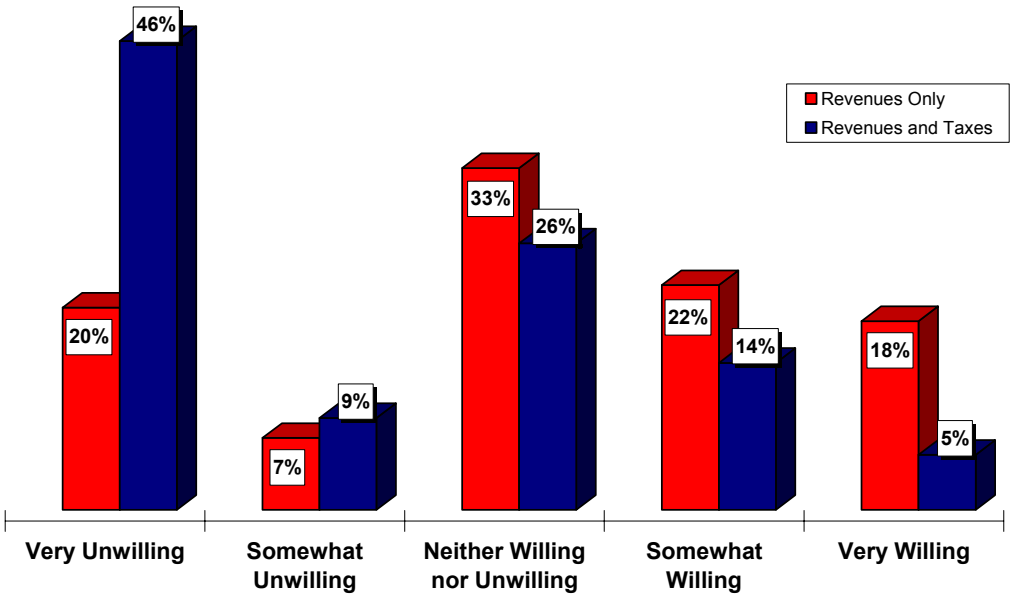


Figure 4.45: Willingness to Support a Communications Service

Kirkland Business Analysis

This section provides further insight and comments on the survey results.

Satisfaction with Internet – Kirkland is shown in Figure 4.46.

Businesses are generally satisfied with their Internet service. In particular, they are satisfied that their service eliminates the need to dialup, but they are slightly less satisfied with the price of service.

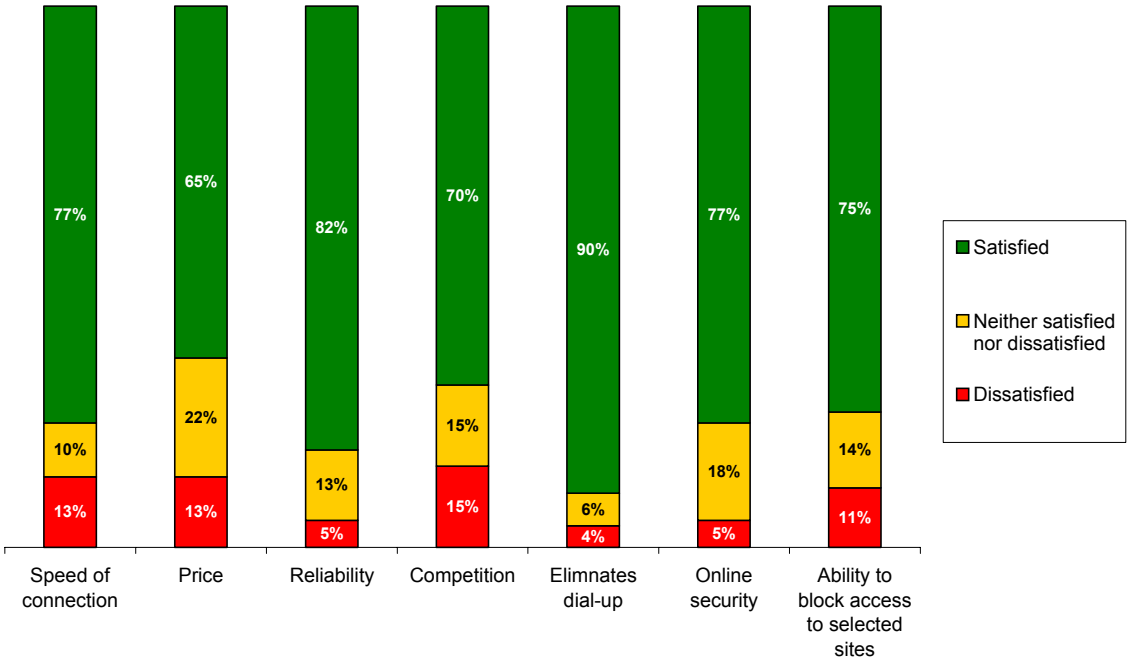


Figure 4.46: Satisfaction of Kirkland Businesses with Internet Service

Businesses place a great deal of importance on the Internet's ability to improve their business as shown in Figure 4.47.

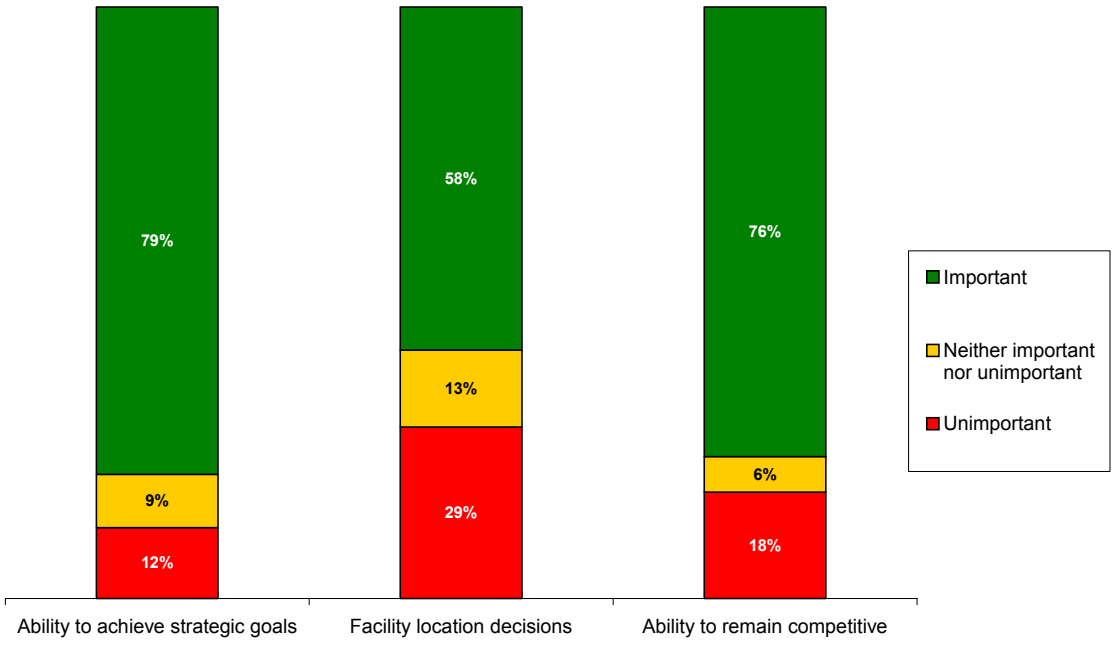


Figure 4.47: Importance of Internet Service to Kirkland Businesses

The appeal of switching Internet service providers in Kirkland is illustrated in Figure 4.48. Over half of businesses would be willing to switch Internet service providers for a faster connection at the same price. A majority of businesses would not be willing to pay more for a faster connection.

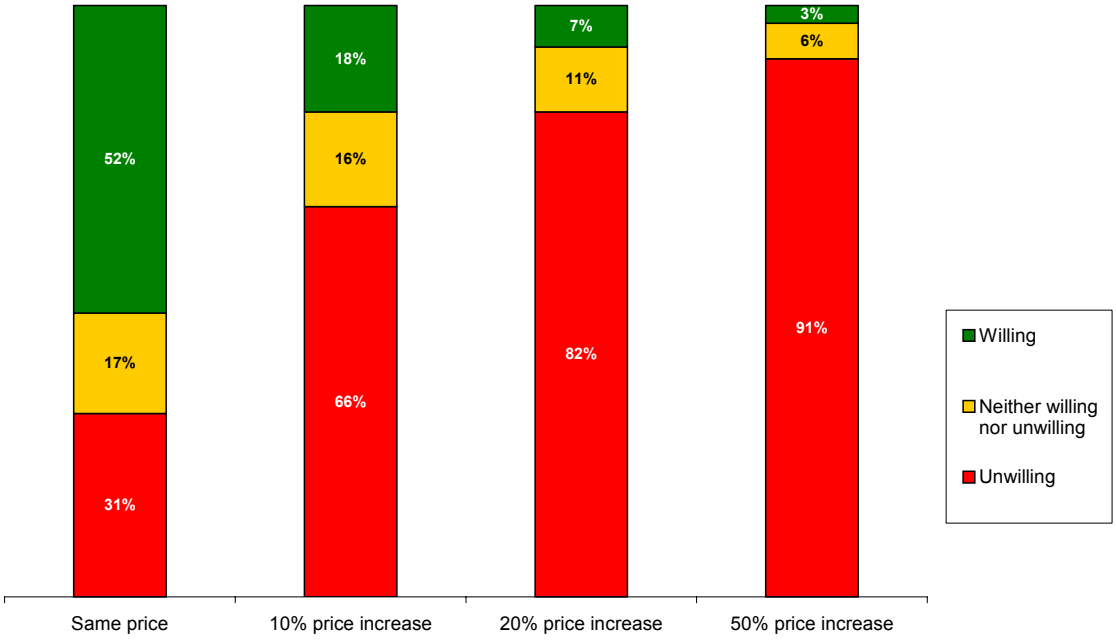


Figure 4.48: Willingness of Kirkland to Switch Internet Service Providers

The willingness of Kirkland businesses to purchase faster Internet access is shown in Figure 4.49. Over one-third of businesses would be willing to pay up to $49 for faster Internet access. A large majority of businesses would not be willing to pay more than $50 for faster Internet access.

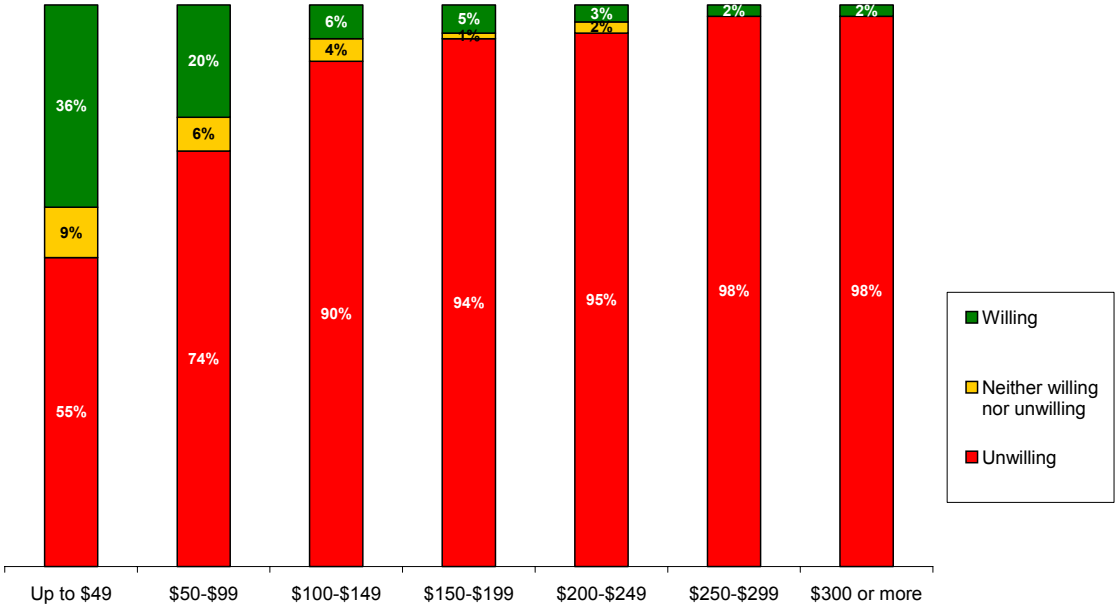


Figure 4.49: Willingness of Kirkland Businesses to Purchase Faster Internet Access

The likelihood of businesses in Kirkland to use Internet for various tasks is shown in Figure 4.50. Nearly half of businesses use the Internet to access information. Forty-one (41) percent of businesses use the Internet to create and maintain a Website. Twenty-six (26) percent of businesses use the Internet for business-to-business e-commerce.

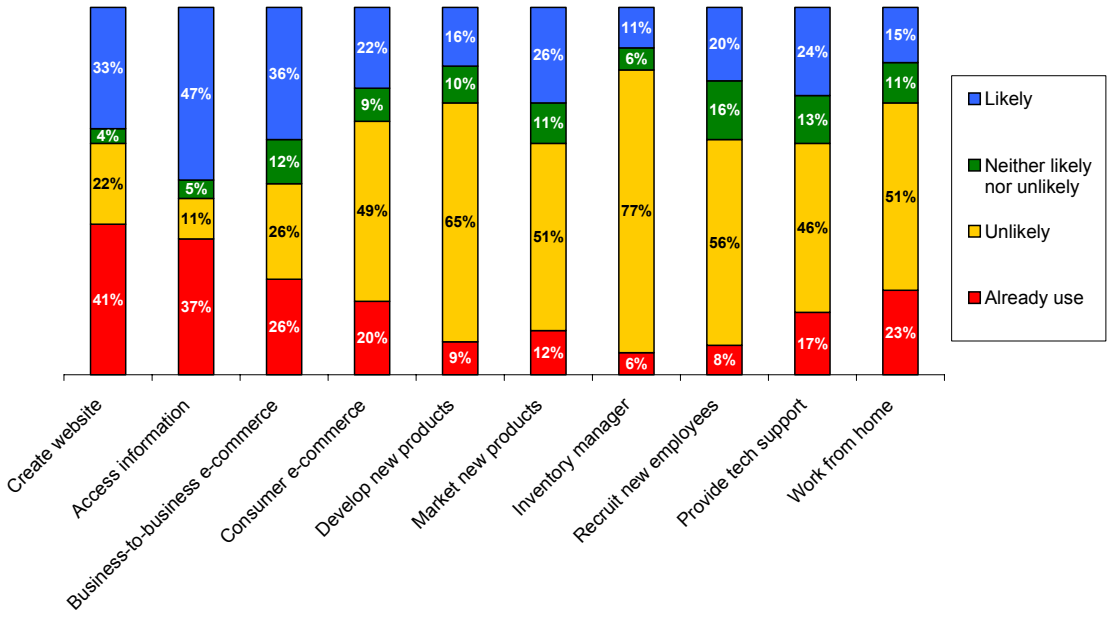


Figure 4.50: Likelihood of Kirkland Businesses Using Internet for Various Tasks

The appeal of switching phone service providers for Kirkland businesses is depicted in Figure 4.51. Nearly two-thirds of businesses would be willing to switch phone services for a 25 percent decrease and nearly one half would be willing to switch for a 10 percent price decrease. A large majority of businesses would not be willing to switch for the same price or a price increase.

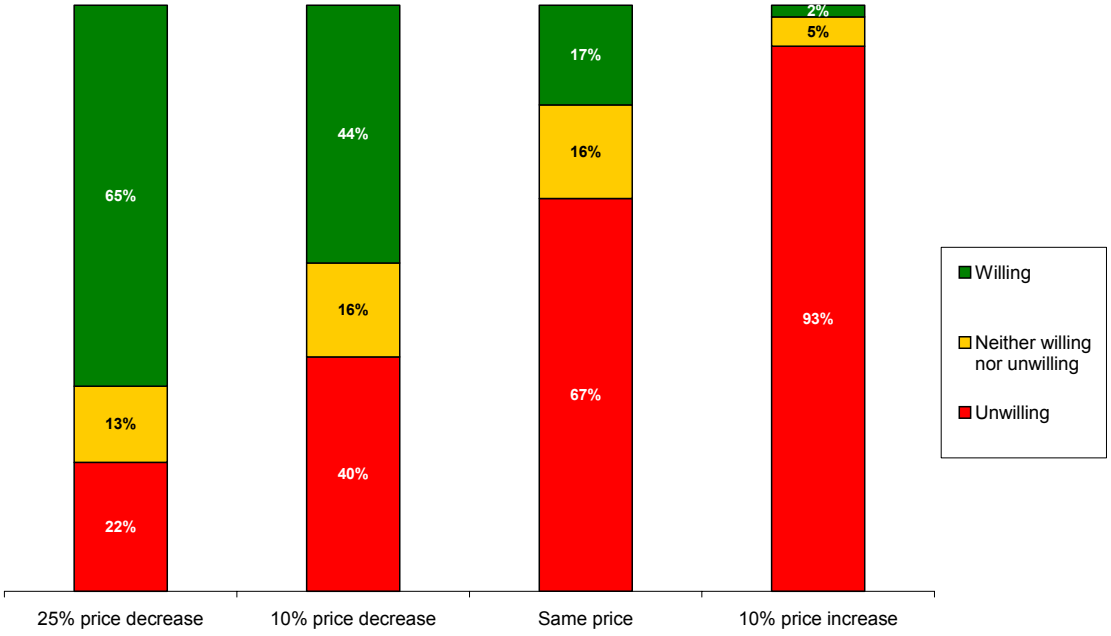


Figure 4.51: Willingness of Kirkland Businesses to Switch Phone Service Providers

The satisfaction of Kirkland businesses with their current phone service is shown in Figure 4.52. Businesses are generally satisfied with their phone service.

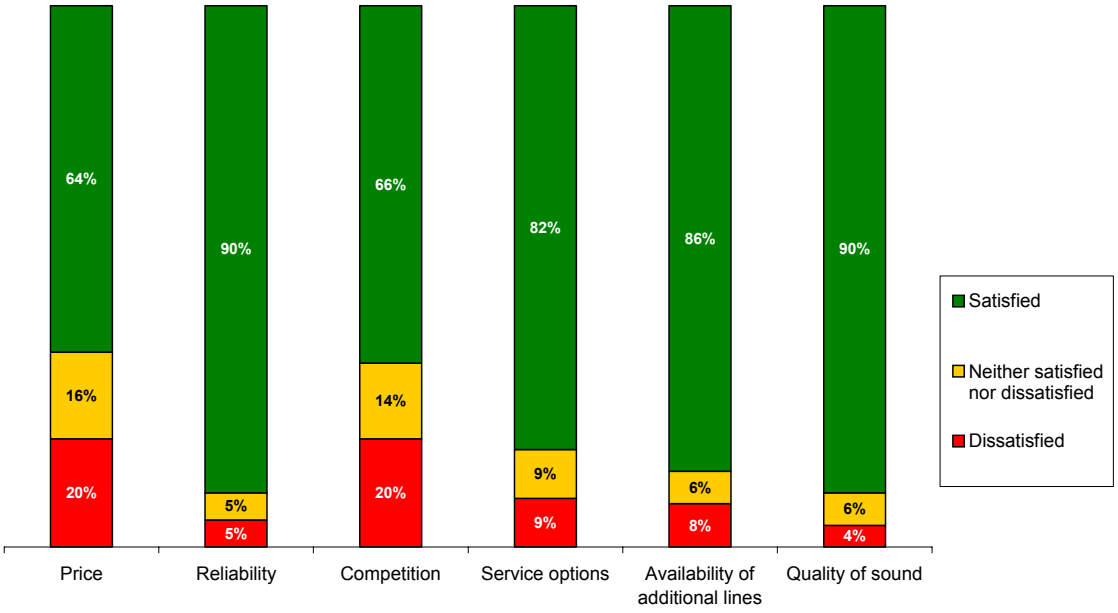


Figure 4.52: Satisfaction with Phone Service – Kirkland

The appeal of switching cable or satellite service providers among Kirkland businesses is shown in Figure 4.53. Over 70 percent of businesses would be willing to switch cable or satellite service providers for a 25 percent decrease and over 60 percent for a 10 percent price decrease. Businesses are generally unwilling to switch for the same price or a price increase.

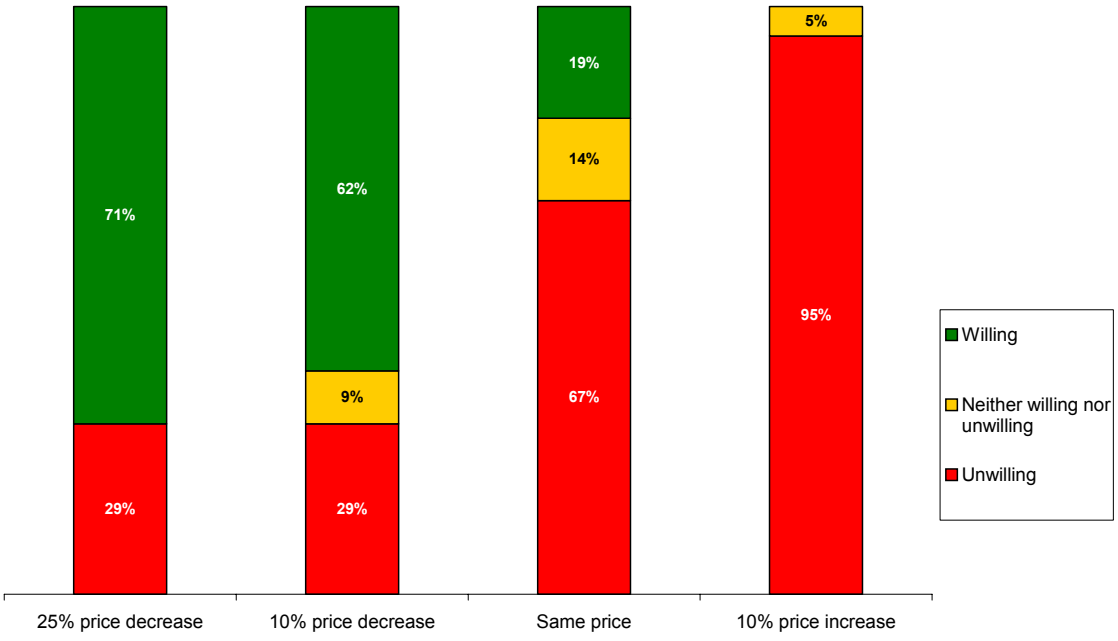


Figure 4.53: Appeal of Switching Cable or Satellite Service Providers, Kirkland Businesses

The satisfaction of Kirkland businesses with current cable or satellite service is shown in Figure 4.54. When it comes to price, a majority of businesses are dissatisfied. In all other areas, businesses are generally satisfied.

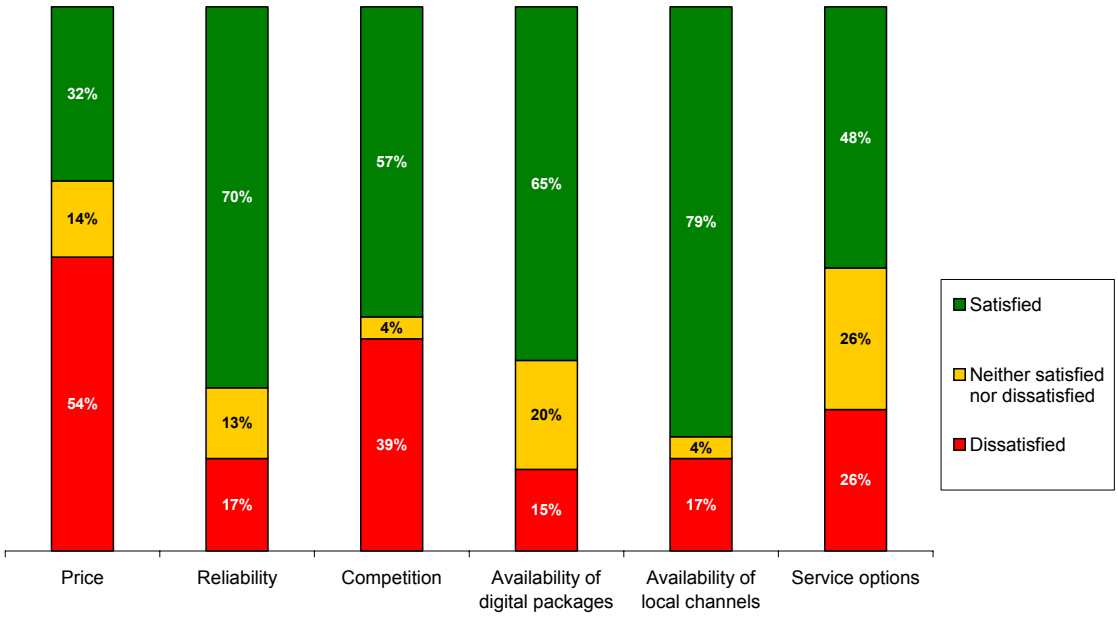


Figure 4.54: Satisfaction with Cable/Satellite Service – Kirkland

The willingness of Kirkland businesses to support city communications is depicted in Figure 4.55. Forty (40) percent of businesses would be willing to support a Kirkland communications system if subscriber revenues alone paid for the service. Only 19 percent of businesses would be willing to support a Kirkland communications system if subscriber revenues and tax money paid for the service.

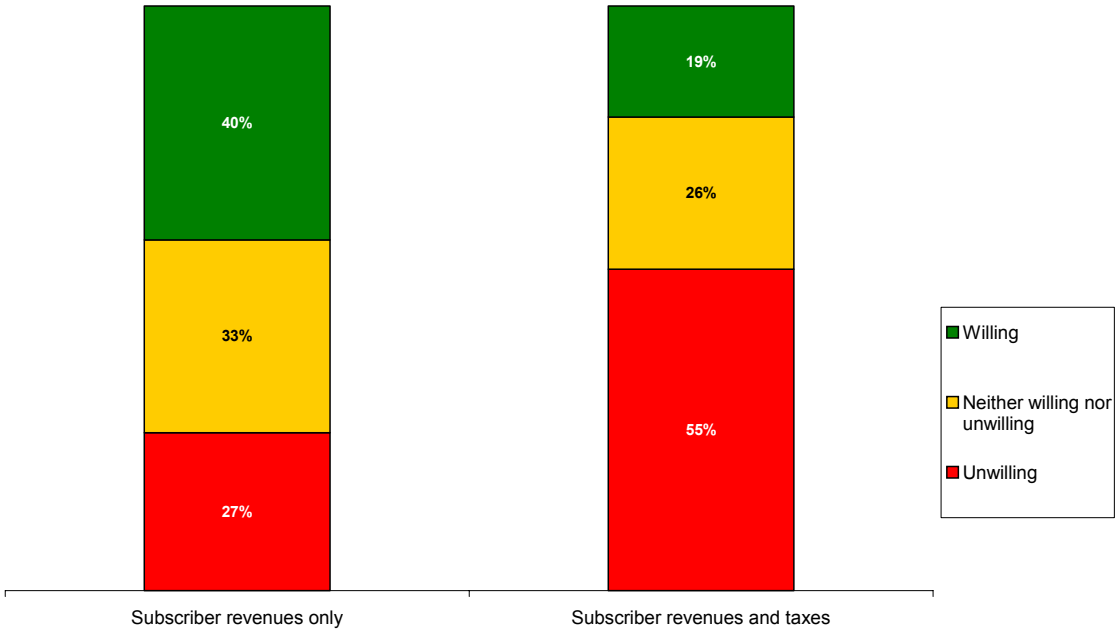


Figure 4.55: Willingness of Kirkland Businesses to Support City Communications

The effect of the use of the Internet on the willingness of Kirkland businesses to switch to high–speed Internet is shown in Figure 4.56. Generally, businesses that intend to use Internet in a number of different ways over the next two years are slightly more willing to switch to high-speed Internet if it is provided at the **same** price as respondents pay now. Higher mean rates of willingness were found among businesses that plan to use the Internet to access information (e.g., about suppliers or competitors) and to create or maintain a company Website.

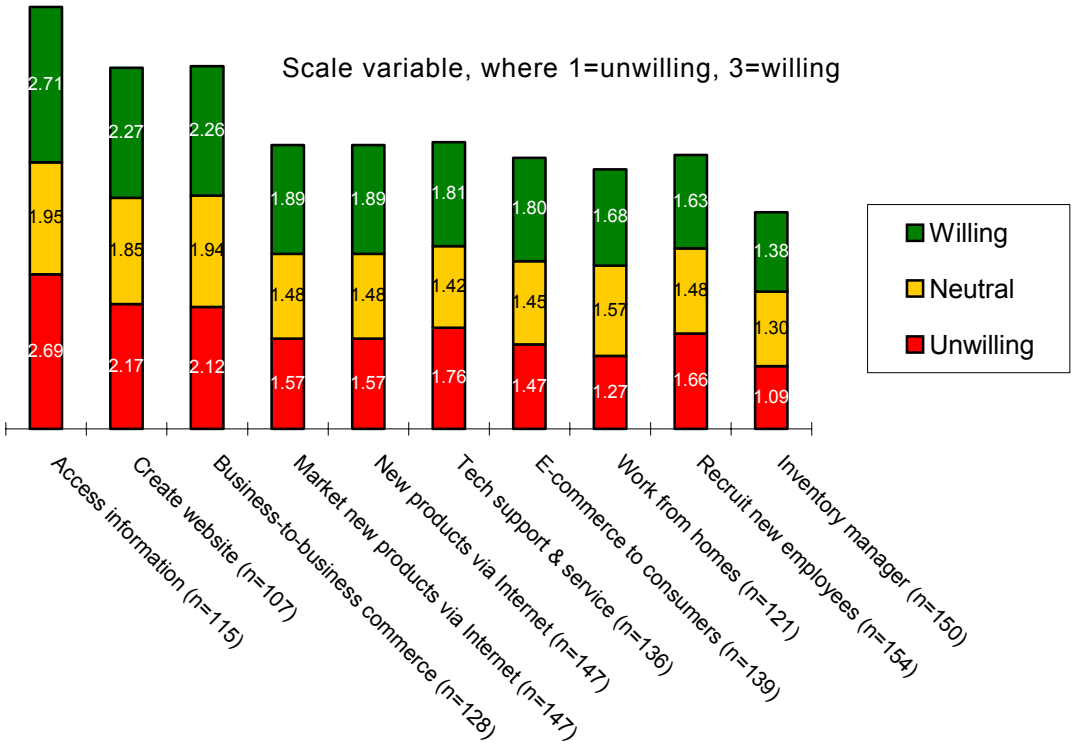


Figure 4.56: Willingness Among Kirkland Businesses to Switch to High-Speed Internet, By Use of the Internet

The likelihood that Kirkland businesses would switch to high-speed Internet access is depicted in Figure 4.57. A majority of businesses (except for Non-profit institutions) would be more likely to switch to high-speed Internet access if it were provided at the same price respondents pay currently. The higher the price, the less willing businesses will be to purchase high-speed Internet access.

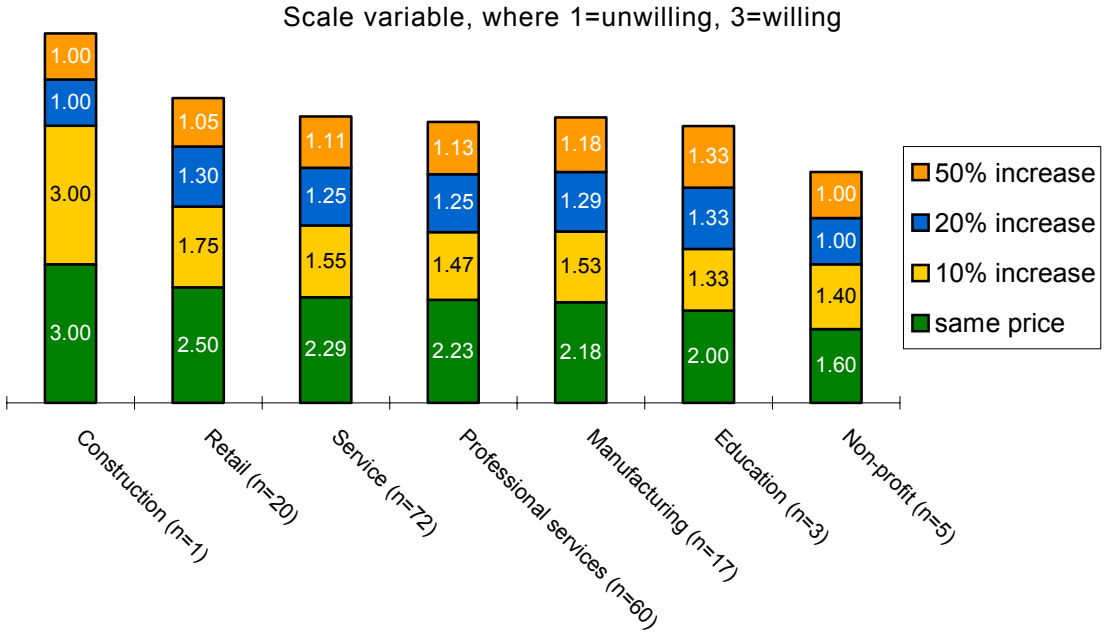


Figure 4.57: Business Type by Switching to High-Speed Internet - Kirkland

Current Satisfaction with Connection Speed by Use of Internet in the Future, Kirkland Businesses

Access to information is the only aspect with which customers expressed a high level of satisfaction. No matter how businesses intend to use the Internet, satisfaction with current connection speed is generally below the midpoint on a scale of 1 to 3.

Correlations Among Kirkland Businesses

Those businesses that assign higher importance to the Internet in achieving their strategic goals are significantly more willing to pay a higher price for a higher connection speed.

Table 4-6: Importance of the Internet to Various Factors

Importance of the Internet in	Increased connection speed			
	Same price	10% increase	20% increase	50% increase
Achievement of strategic goals	.193*	.066	.140*	.142*
	N=185	*N=180*	*N=182*	*N=182*
Facility location decisions	.018	.042	.118	.089
	N=170	*N=166*	*N=167*	*N=167*
Ability to remain competitive	.087	.023	.070	.127
	N=183	*N=178*	*N=180*	*N=180*

* Significant if p<0.05

Additional analysis shows the importance assigned to the Internet in these three functions is largely unrelated to satisfaction with the price of access.

Table 4-7: Perception of Connection Speed

Satisfaction	Achievement of strategic goals (n=198, 169)	Facility location decisions (n=182, 155)	Ability to remain competitive (n=194, 165)
Connection Speed	.073	.022	.209*
Price	-.067	.038	-.032

* Significant if p<0.05

Aggregate Business Cross Tabs

Combining Bellevue and Kirkland survey information for the cross tab output provided nearly the same conclusions as doing each separately. For a complete list of the aggregate business cross tabs and for each individual city, please see the Exhibits.

Over half of all business types have Internet access. Manufacturing has the highest (95) percentage and Retail has the lowest (55) percentage of business type with Internet access, as shown in Figure 4.58.

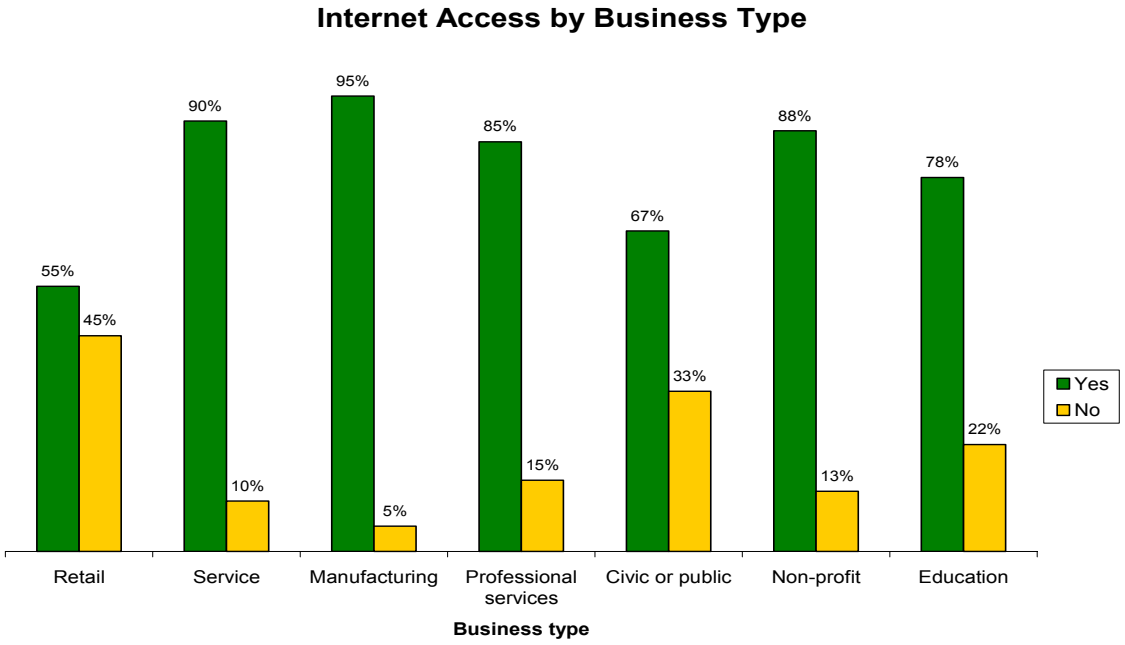


Figure 4.58: Internet Access by Business Type

Almost all business types have high-speed Internet connections, mainly DSL and satellite, as seen in Figure 4.59.

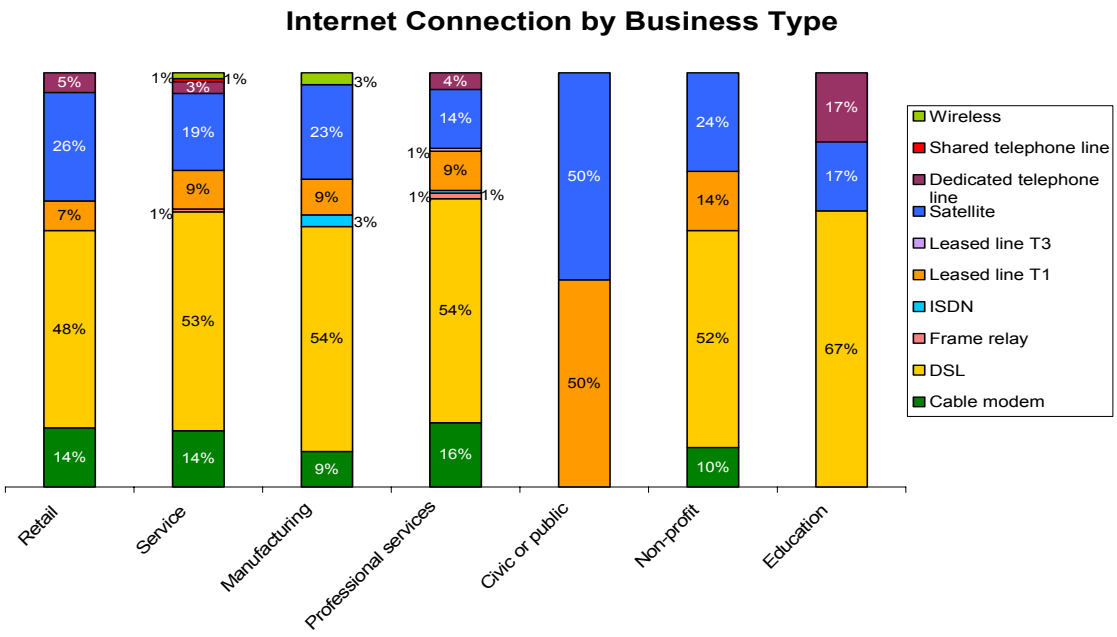


Figure 4.59: Internet Connection by Business Type

Among all business types, the majority believes that the main role for the city is to make rules to promote competition among providers and facilitate access to electronic information and services. This was followed by those who indicated the city should have no role. See Figure 4.60.

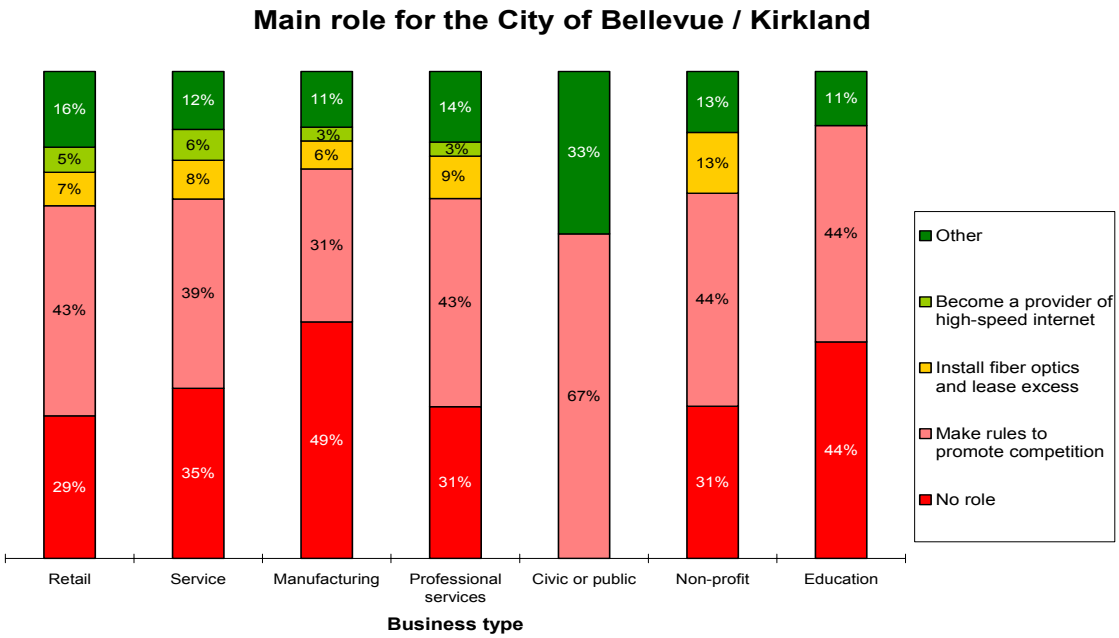


Figure 4.60: Main Role for the City

All business types were almost equally split among "willing," "neither willing nor unwilling," and "unwilling" to support a plan in which the city offered a communication service (cable television, telephone, Internet) financed by subscriber revenues only. Education was the most unwilling sector to support such a plan. Most business types were fairly unwilling to support a plan in which the city offered a communication service that was financed by subscriber revenues and taxes. The only exception is non-profits who indicated they are slightly more willing than unwilling to support such a plan. This information is presented in Figures 4.61 and 4.62.

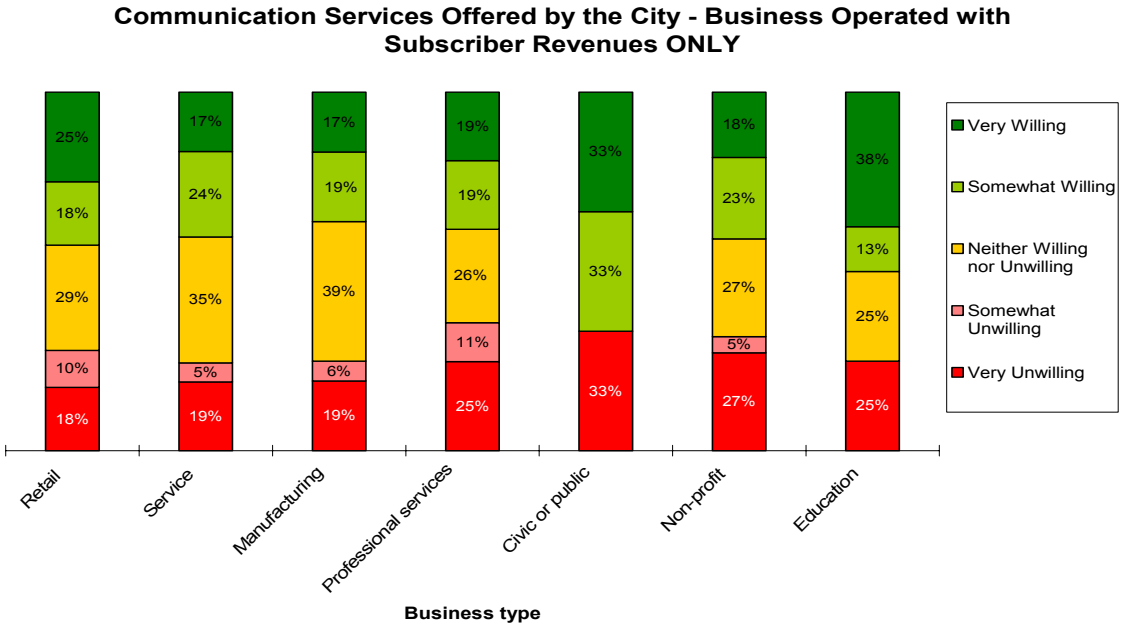


Figure 4.61: Willingness to Support Communication Services Financed With Subscriber Revenues ONLY

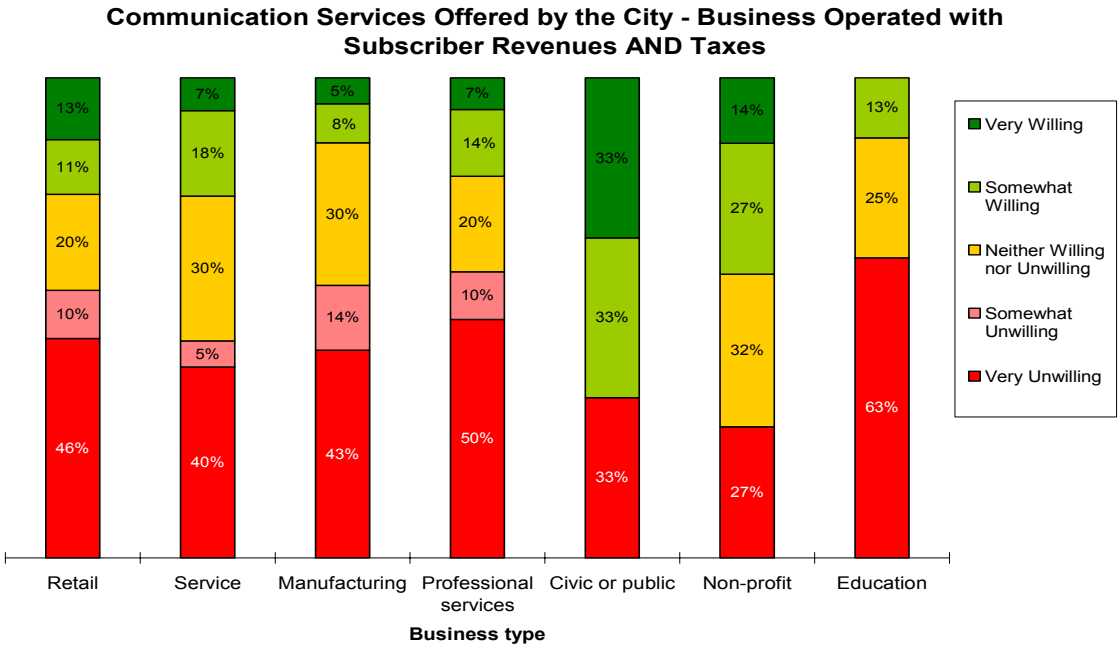


Figure 4.62: Willingness to Support Communication Services Financed With Subscriber Revenues AND Taxes

Businesses that access the Internet using a high-speed connection had similar thoughts about their willingness to support a plan in which the city offered a communication service financed by subscriber revenues to low-speed connection users. When asked whether they would support a plan that financed by subscriber revenues and taxes, however, opinions shifted. Low-speed connection users were unwilling to support such a plan. See Figures 4.63 and 4.64.

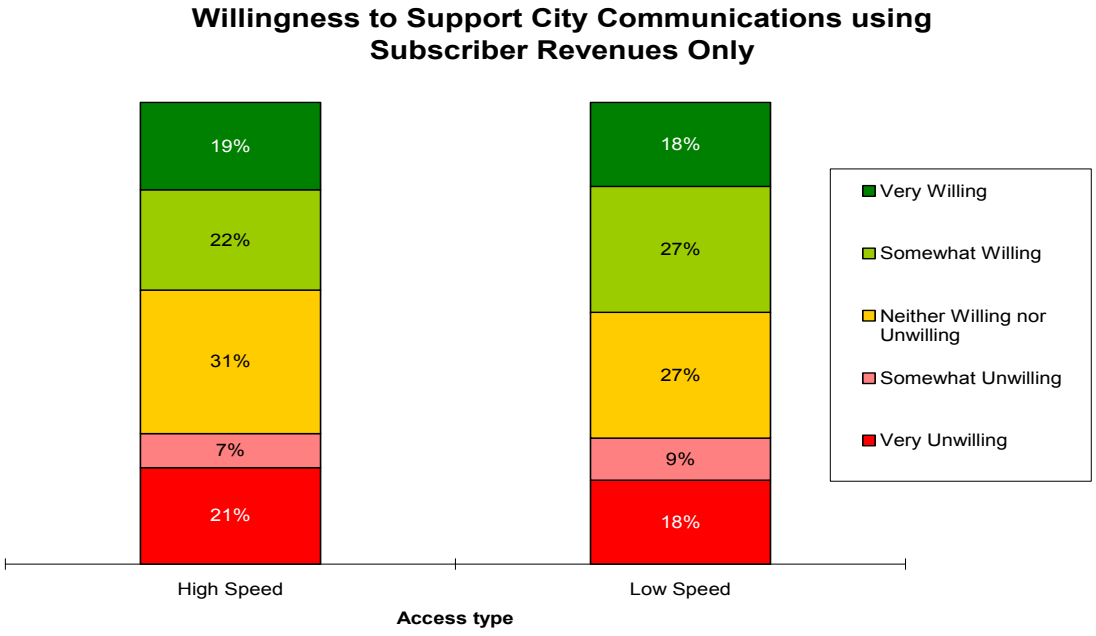


Figure 4.63: Subscriber Revenues ONLY

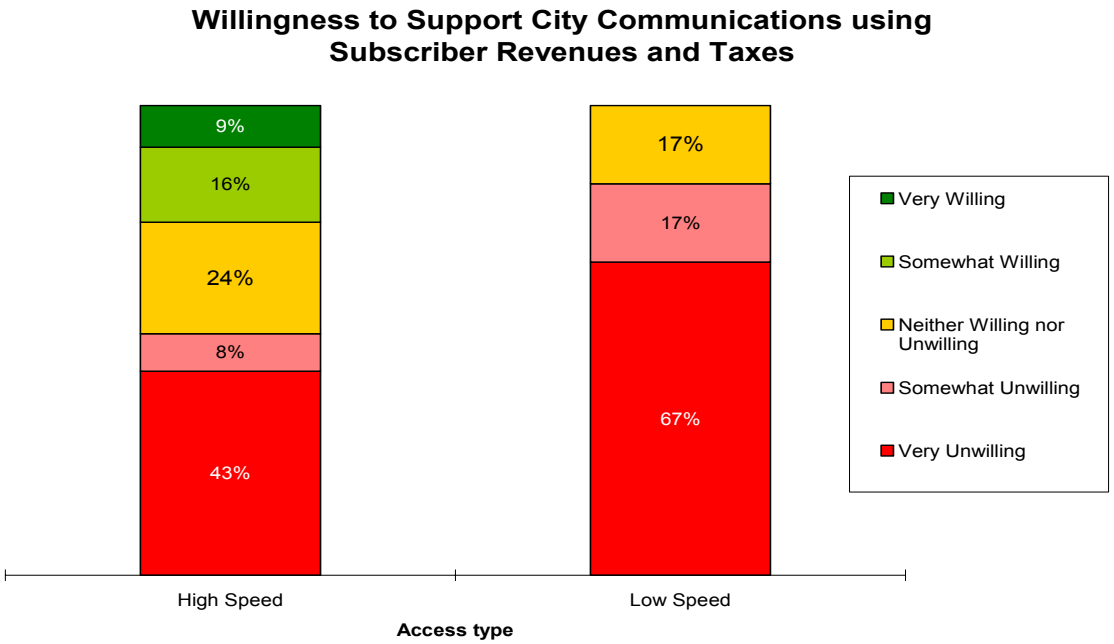


Figure 4.64: Subscriber Revenues AND Taxes

4.4 Customer Value Management

Customer Value Management (CVM) is a market research and analysis methodology that can help find out what drives customers' purchasing decisions, how loyal they are, and what factors would cause them to switch to a competitor. CVM provides benchmark comparative data on performance based on the customer perspective. Measured over time, CVM can help businesses more effectively serve customers.

This section summarizes the CVM methodology, individual results from the survey of Bellevue and Kirkland residents and aggregate results from the survey of Bellevue and Kirkland businesses.

Introduction

The basic philosophy behind Customer Value Management is:

- Customer satisfaction and loyalty depend on how customers perceive a firm to be performing relative to other, similar service providers and their expectations of quality; and
- tone can create an index of performance based on attributes that are important to customers and mark for improvement those areas that provide the customers with the greatest perceived performance improvement.

In this case, we have collectively defined "Customers" as customers of Internet providers, local telephone providers, cable and satellite television providers, and/or municipal water providers. The Customer Value Management methodology consists of three main steps:

1. Generate a list of attributes of service common to the relevant utilities and surveying customers to determine how important each of these attributes are to providing utility service.
2. Measure initial customer perceptions of each utility's performance in each of these attributes of service.
3. Measure, over time, how the perceived quality and price of each utility's service changes in relation to the service of their competitors.

Intuitively, one would expect that generating greater perceived value—that is, higher quality at a lower price—would result in a high market share. Indeed, this has been repeatedly shown in industry studies. For the purposes of a feasibility study, a CVM approach is valuable because it shows—

- Which attributes of connectivity services, such as telephone and Internet services, customers view as being "must haves."
- Which attributes of connectivity services are most likely to increase customers' happiness.
- Which attributes to focus on in efforts to improve services.

- How secure incumbent providers are in their market position—that is, how well their perceived quality is matched by their perceived cost of service.
- Whether the current image of the Cities of Bellevue and Kirkland as service providers will be of any help in convincing customers to switch, if they eventually offer new services.

What Customers Say Is Important Vs. What Actually Drives Satisfaction

In order to understand the CVM data, one must first understand the difference between what customers say is important and what actually drives customer satisfaction, and how these different perspectives are interpreted.

- The "what customers say is important" method involves asking the customer to rank each attribute in order of importance. These rankings are used to calculate weights for each attribute of utility service. Attribute weights calculated using this method tend to focus more heavily on those attributes, if any, that have become standard offerings of any company selling that service or product.
- The "what actually drives customer satisfaction" method uses statistical techniques to correlate the customers' perceptions of the utility's performance with overall satisfaction ratings. Attribute weights obtained using indirect methods provide more of an insight into the actual determinants of customer satisfaction.

This is not to imply that the attribute weights determined through the "what customers say is important" method are invalid or not valuable. Although doing well on attributes that are weighted heavily according to this method will not necessarily make the customer appreciably happier, neglecting these issues will have significantly negative effects. An analogy may be helpful in understanding this distinction.

Consider the market for lamps, and suppose lamps have four attributes:

1. Design
2. Brightness
3. Price
4. On/Off Switch

If a customer were asked to rank which of these attributes was most important, he or she would clearly rank having an on/off switch as an important feature. However, on/off switches are so common that they are considered to be a standard feature of a lamp. In other words, very few lamps today lack an on/off switch. This attribute would likely be highly weighted if customers were asked to rank the attributes.

On the other hand, it probably is not the case that a customer's overall satisfaction with a certain lamp depends on the presence of an on/off switch. More likely, the customer will be attracted to the design of the lamp or some other attribute. In other words, an attribute other than an on/off switch would likely be more heavily weighted when using the "what actually drives customer satisfaction" approach.

This difference is particularly noticeable in the utility industry where the only direct interaction between the provider and the customer is through customer service. Most customers take the reliability of their service more or less for granted. Even though customers would recognize reliability as a very important attribute of utility service, their perceptions about the performance of the utility can be heavily influenced by interactions with the utility, especially the most recent interaction.

In the next sections, we will provide comparisons of the four utilities included in the survey: Internet, local telephone, cable/satellite television, and the municipal water utility.

1. Bellevue Residential Utility Comparisons

Figure 4.65 shows how, in the eyes of Bellevue residents, each utility (local telephone, Internet and cable television) is performing relative to other similar service providers. The results of both weighting methods are shown in Figure 4.65.

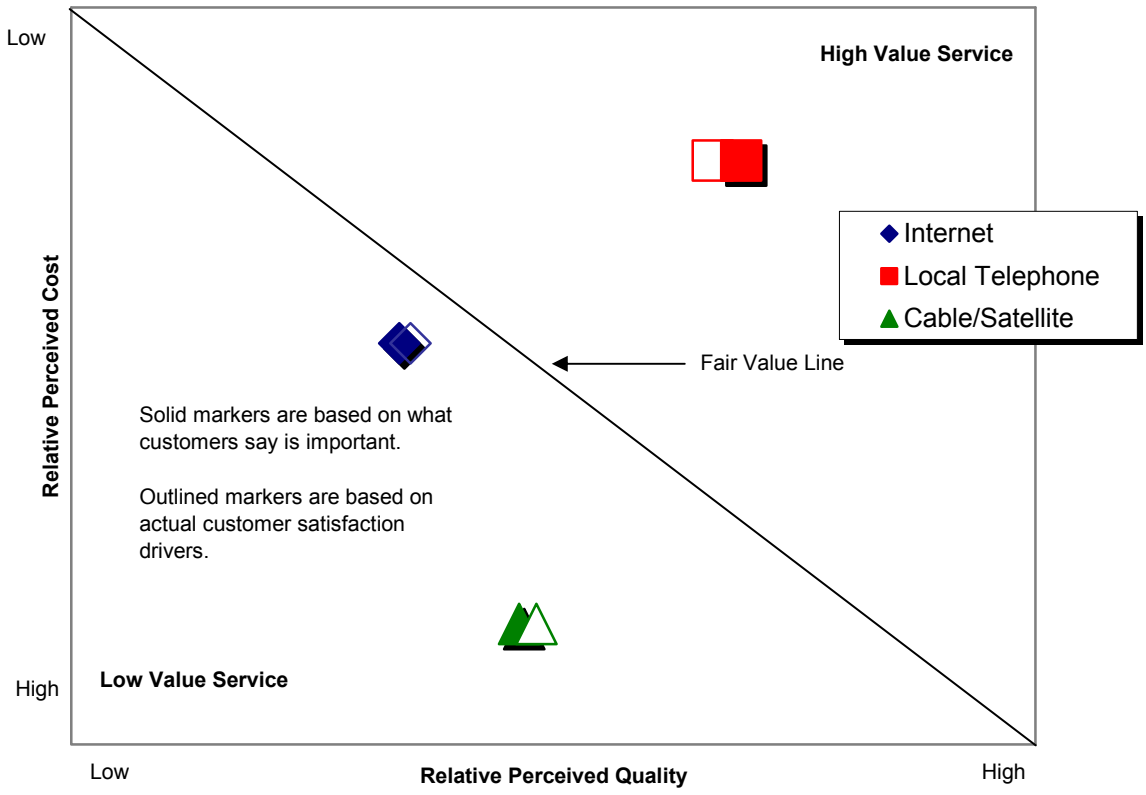


Figure 4.65: Bellevue Residential – Customer Value Map

In the figure above, the line in the middle represents the "fair value line," at which the price paid for a service is exactly balanced by the quality of that service. Data points above this line indicate that the service provider is returning high quality relative to the price of its service.

- Bellevue residential customers feel that the local telephone providers are providing a high value service relative to the Internet and cable providers. This was true using either weighting system. The reasons behind the local telephone provider's perceived high value will be discussed below.
    - The reasons behind the local telephone provider's perceived high value will be discussed below.
- Internet customers feel they are receiving nearly fair value service from Internet providers.
- Cable customers feel the price paid for services is too high, but the quality is slightly higher than the Internet providers.

As Table 4-8 shows, for Bellevue residential customers, the two weighting methods lead to similar attribute importance weights. The sum of attribute category weights—that is, reliability, rates, customer service—equals 100 percent. Each attribute category consists of sub-attributes. The weights of these sub-attributes sum to 100 percent for each attribute category.

As expected, the "what customers say is important" weighting system shows that utility reliability is the most important utility service attribute category according to business customers. This is followed by rates charged for service and customer service.

The "what actually drives customer satisfaction" weighting system, as mentioned in the introduction, indicates which attributes of service have the greatest effect on customer happiness. We see that reliability is again of highest importance here. However, it is followed more closely by customer service. The importance of rates charged for service appears to have gone down in importance using the "what actually drives customer satisfaction" method.

Table 4-8: Attribute Weights Table, Bellevue Residential Utilities

	What Customers Say is Important	Actual Customer Satisfaction Drivers
Customer Service	**15%**	**34%**
Utility Reliability	**62%**	**50%**
Rates Charged for Service	**23%**	**16%**
Total	**100%**	**100%**

Figures 4.66 and 4.67 describe the importance and performance within each main attribute category. They show that Bellevue residents consider reliability to be the most important attribute using either weighting method.

- The Bellevue local telephone provider outperforms the Internet and cable providers in all attributes. This is particularly true of the reliability and rates charged for service attributes, which led to the local telephone provider being regarded as a high-value service provider on the Customer Value Map (Figure 4.71).

- The cable television providers were perceived as providing better reliability but having higher rates than the Internet providers.

- Residential customers perceived the Internet providers as performing slightly worse than the cable and local telephone providers on the customer service attribute.

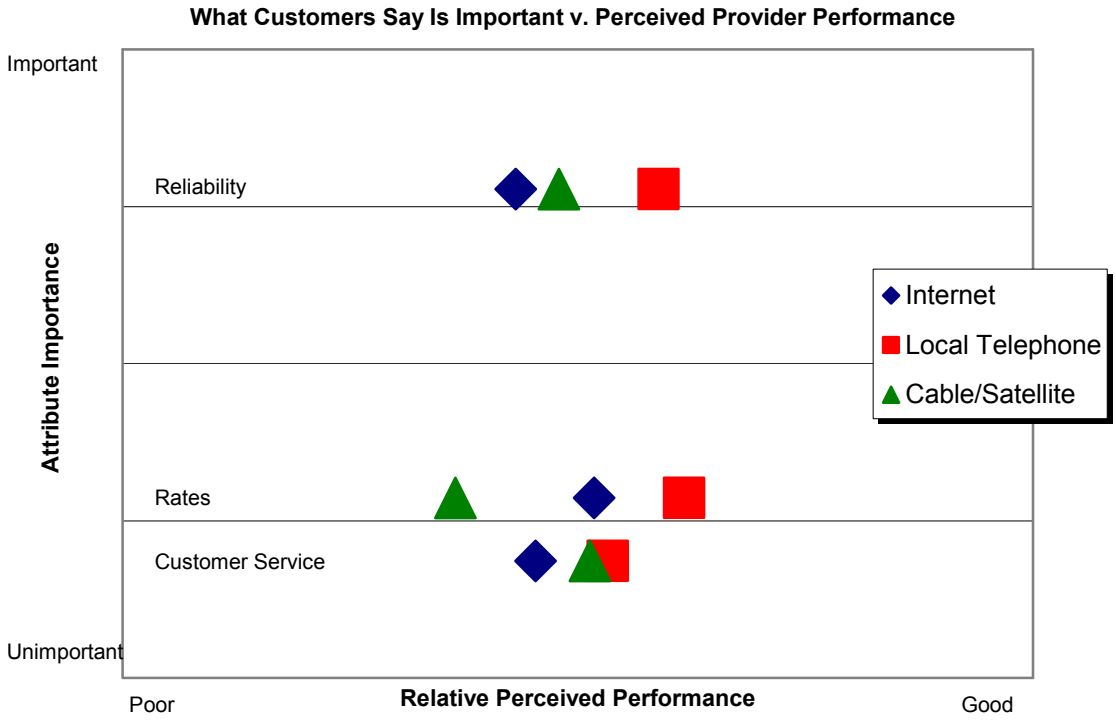


Figure 4.66: What Customers Say Is Important v. Perceived Provider Performance

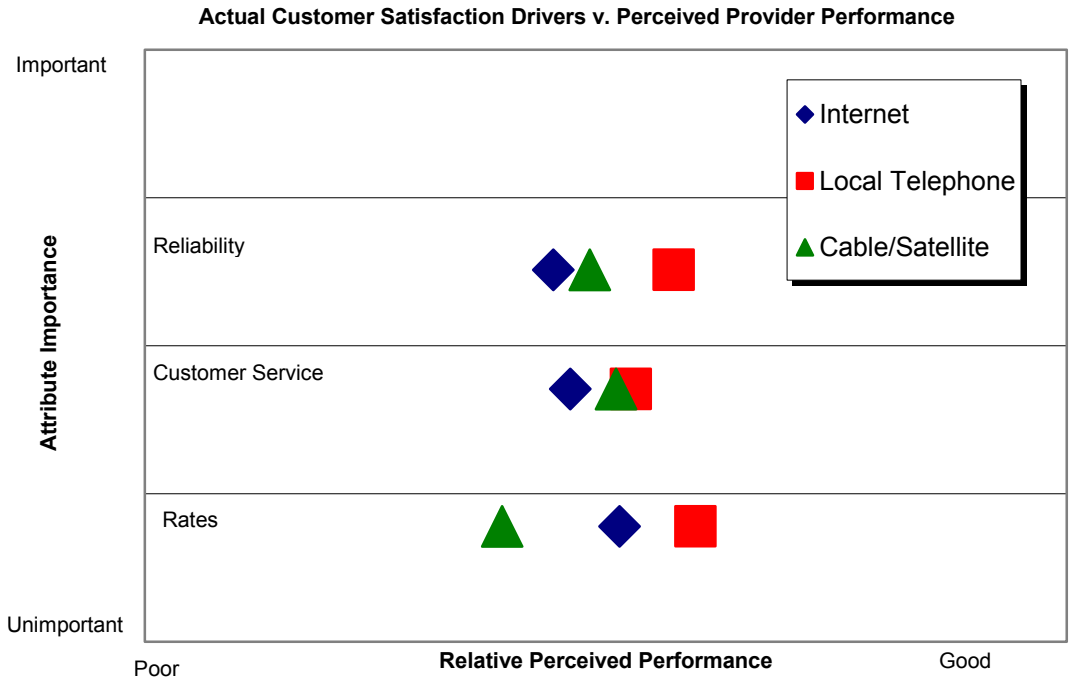


Figure 4.67: Actual Customer Satisfaction Drivers v. Perceived Provider Performance

2. Kirkland Residential – Utility Comparison

Figure 4.68 illustrates how, in the eyes of Kirkland residents, each utility (local telephone, Internet and cable television) is performing relative to other, similar service providers. The results of both weighting methods are shown. The line in the middle represents the "fair value line," at which the price paid for a service is exactly balanced by the quality of that service. Data points above this line indicate that the service provider is returning high quality relative to the price of its service.

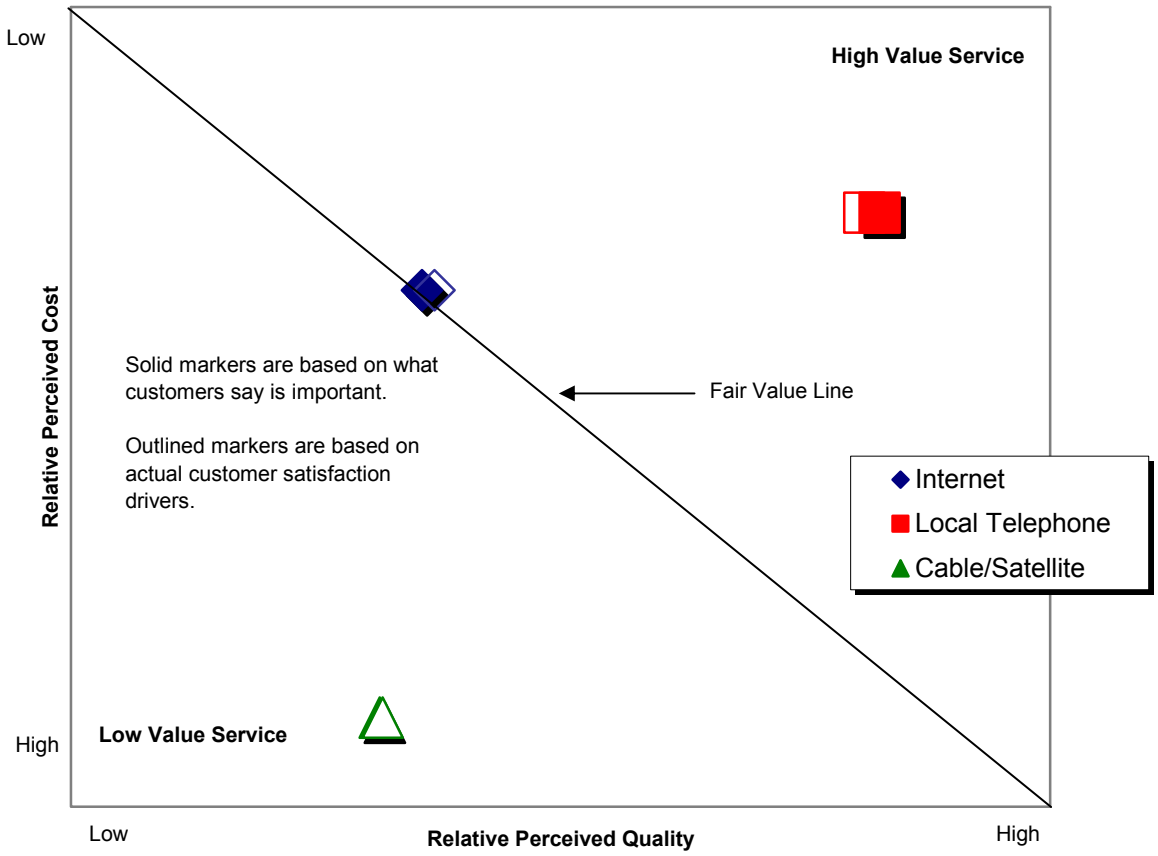


Figure 4.68: Kirkland Residential – Customer Value Map

- Kirkland residential customers feel that the local telephone providers are providing a high-value service relative to Internet and cable providers. This was true using either weighting system. The reasons behind the local telephone provider's perceived high value will be discussed below.

  - The reasons behind the local telephone provider's perceived high value will be discussed below.

- Internet customers feel they are receiving nearly fair value service from Internet providers.
- Cable customers feel the price paid for services is too high but the quality is about the same as that provided by Internet providers.

As Table 4-9 shows, for Kirkland residential customers, the two weighting methods lead to similar attribute importance weights. The sum of attribute category weights (reliability, rates, customer service) equals 100 percent. Each attribute category consists of sub-attributes. The weights of these sub-attributes sum to 100 percent for each attribute category.

As expected, the "what customers say is important" weighting system shows that utility reliability is the most important utility service attribute category, according to business customers. This is followed by rates charged for service and customer service.

The "what actually drives customer satisfaction" weighting system, as mentioned in the introduction, gives an indication of what attributes have the greatest effect on customer happiness. We see that reliability is again of highest importance. The importance of rates charged for service and customer service appear to have reversed, with customer service becoming the second most important attribute behind reliability.

Table 4-9: Attribute Weights Table, Kirkland Residential Utilities

	What Customers Say is Important	Actual Customer Satisfaction Drivers
Customer Service	8%	25%
Utility Reliability	63%	62%
Rates Charged for Service	29%	13%
Total	100%	100%

The two figures that follow (Figures 4.69 and 4.70) describe the importance and performance within each main attribute category. They show that Kirkland residents consider reliability to be the most important attribute using either weighting method.

- The Kirkland local telephone provider outperforms the Internet and cable providers in all attributes. This is particularly true of the reliability and customer service attributes that led to the local telephone provider being regarded as a high-value service provider on the Customer Value Map (Figure 4.95).

- The cable television providers were perceived as the weakest performer, particularly on the rates category. This is also evident in the Customer Value Map above, where the cable providers performed nearly as well as the Internet providers on quality attributes (reliability and customer service) but were perceived as exacting a higher price for services received.

- Residential customers perceived the Internet providers as performing nearly as well as the local telephone provider on rates but were outperformed by the telephone provider on reliability and customer service.

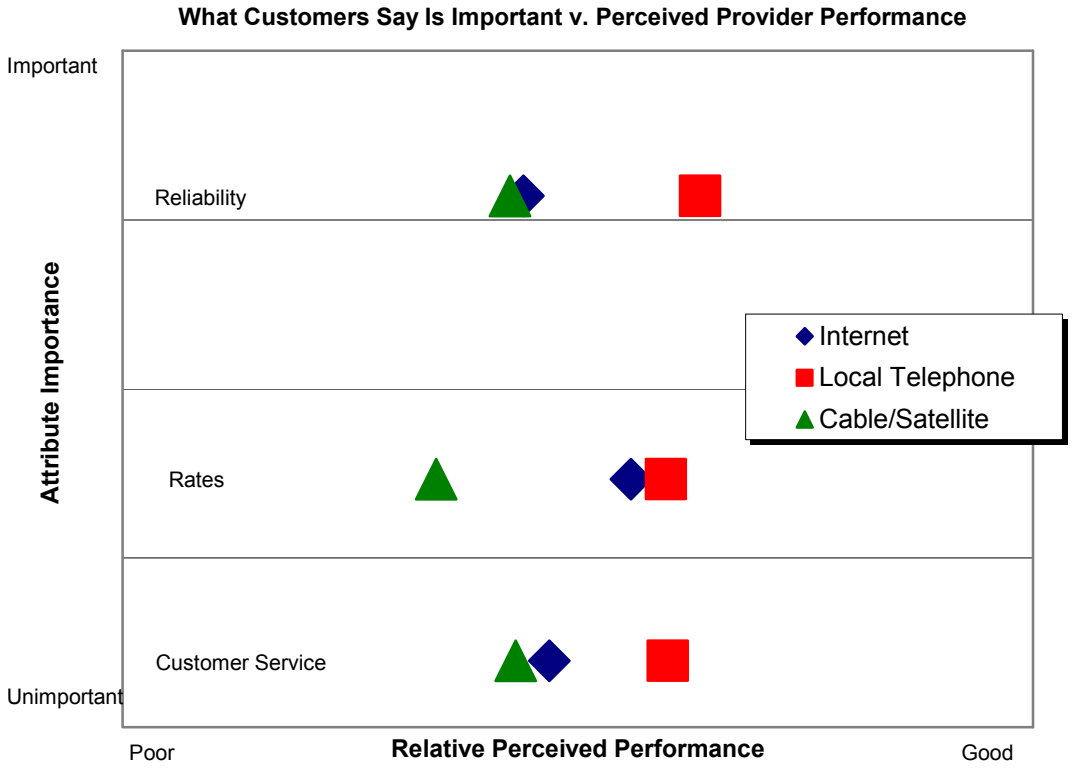


Figure 4.69: What Customers Say Is Important v. Perceived Provider Performance

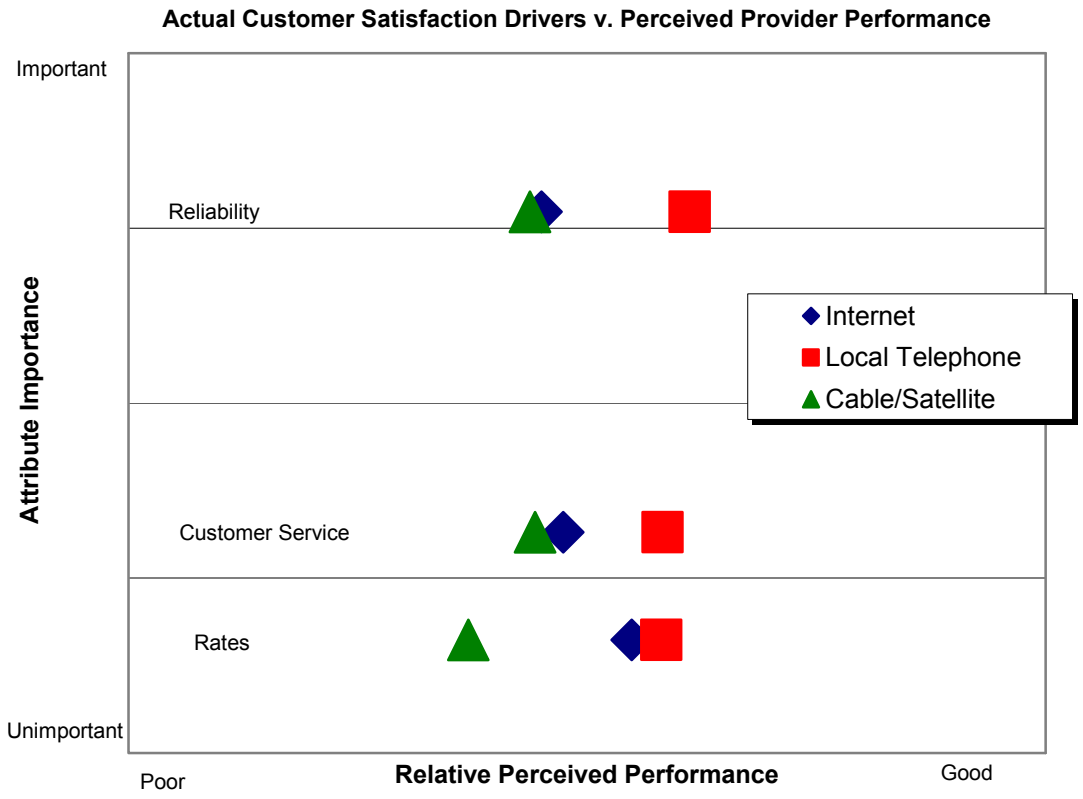


Figure 4.70: Actual Customer Satisfaction Drivers v. Perceived Provider Performance

Utility Comparisons

Figure 4.71 shows how, in the eyes of Bellevue and Kirkland businesses, each utility (Internet, local telephone, cable/satellite television, and the municipal water utility) is performing relative to other similar service providers. The results of both weighting methods are shown.

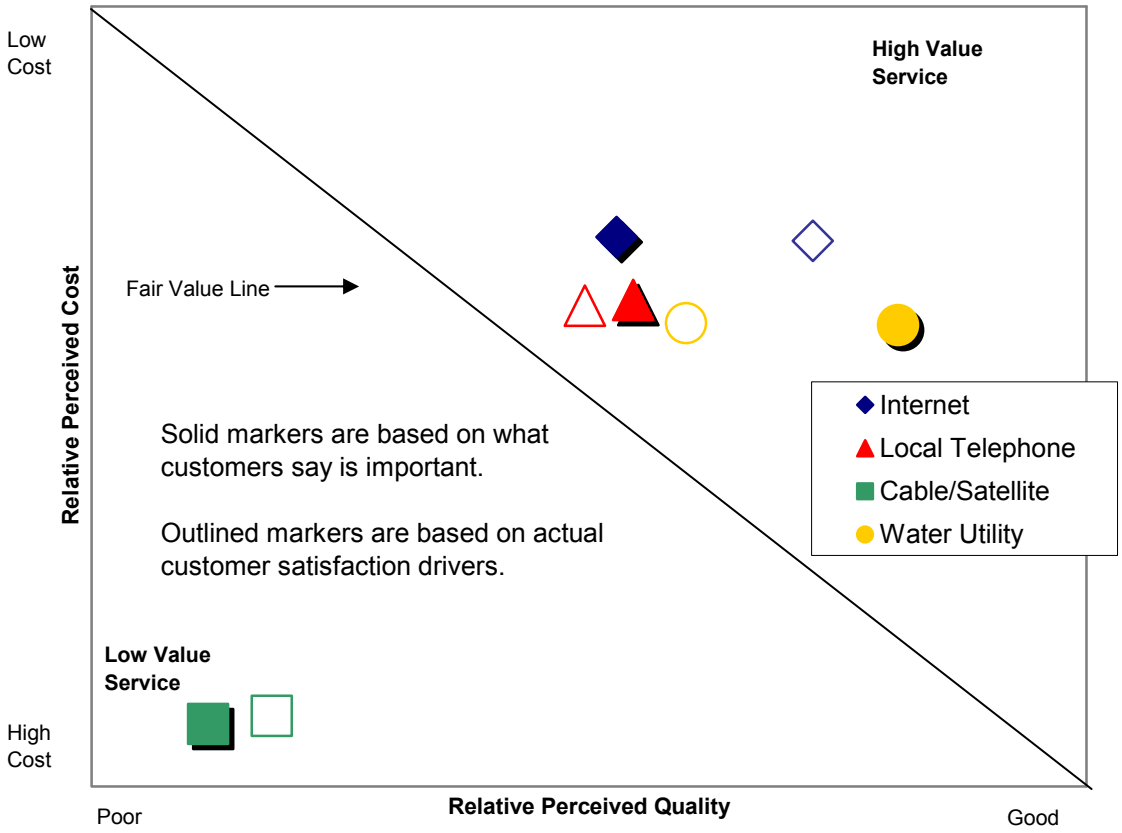


Figure 4.71: Customer Value Map

In Figure 4.71, the line in the middle represents the "fair value line," at which the price paid for a service is exactly balanced by the quality of that service. Data points above this line indicate that the service provider is returning high quality relative to the price of its service.

- Bellevue and Kirkland businesses feel that water, Internet and local telephone providers are providing a high-value service. These three services are perceived as providing high value using either weighting system.
- Cable customers feel the price paid for services is too high and the quality is relatively lower than the other providers.

- The municipal water utilities value is less for the "what actually drives customer satisfaction" method when compared to the "what customers say is important" method. An analysis of the sub-attributes will help identify the reason for these differences.
- The Internet providers have the highest-value service for the "what actually drives customer satisfaction" method.

The overall[33] CVM results for Bellevue and Kirkland businesses are similar to other communities. There are some unique characteristics, however:

- The shift between the methods for the water utility.
- The high ranking of the Internet services (often Internet receives low ratings).

Table 4-10 confirms that the two weighting methods lead to different attribute weights. The sum of attribute category weights (reliability, rates, customer service, and community service) equals 100 percent. Each attribute category consists of sub-attributes. The weights of these sub-attributes sum to 100 percent for each attribute category.

As expected, the "what customers say is important" weighting system shows that utility reliability is the most important category, according to business customers. This is followed by rates charged for service and customer service. Community service weight is close to zero.

The "what actually drives customer satisfaction" weighting system, as mentioned in the introduction, gives an indication of those attributes of service that have the greatest effect on customer happiness. We see that customer service is of highest importance here, followed by utility community service. The importance of reliability and rates appear to be close to zero using the "what actually drives customer satisfaction" method.

[33] The comparisons of sub-attributes vary greatly from one community to another.

Table 4-10: Attribute Weights Table

	What Customers Say is Important	Actual Customer Satisfaction Drivers
Utility Reliability Attributes		
Restores Service Quickly After an Outage	74%	81%
Communicates Nature of Service Disruption	5%	5%
Communicates Anticipated Length of Service Disruption	21%	14%
Utility Reliability	**51%**	**6%**
Utility Rates Attributes		
Maintains Stable Rates	42%	32%
Offers Optional Rate Plans	5%	5%
Offers Reasonable Rates for Basic Service	48%	58%
Offers Reasonable Rates for Installation/Hook-Up Charges	5%	5%
Utility Rates	**24%**	**5%**
Customer Service Attributes		
Treats Customers As If Valued	27%	12%
Does Job Right the First Time	47%	34%
Accurate Information	21%	5%
Offers Alternative Payment Options	5%	48%
Customer Service	**20%**	**57%**
Community Service Attributes		
Offers Programs to Help Low-Income Customers	49%	5%
Active Community Involvement	41%	90%
Local Contact/Presence	11%	5%
Community Service	**5%**	**32%**

The series of figures that follows describes the importance of sub-attributes within each main attribute category.

Figures 4.72 and 4.73 show that Bellevue and Kirkland businesses consider restoring service quickly after an outage to be of highest importance within the reliability category, regardless of weighting method.

- Bellevue and Kirkland municipal water service outperforms similar service providers in all reliability sub-attributes.
- The cable television providers consistently score the worst in reliability sub-attributes.
- Customer perceptions of reliability performance for telephone and Internet are similar.

As seen in Table 4-10, customer service is the most important driver for improving customer satisfaction. This is not to say that reliability is not important. Reliability is expected and is a requirement to stay in business; it is not, however, a factor in distinguishing a business from a potential competitor.

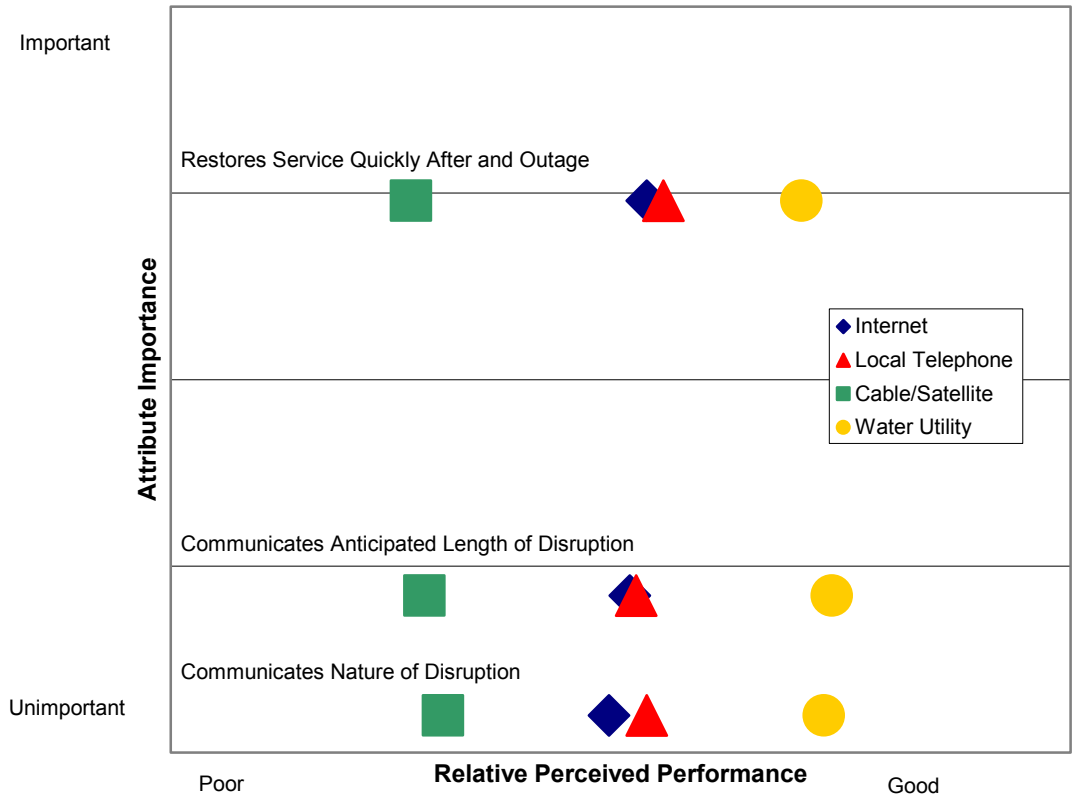


Figure 4.72: What Customers Say Is Important v. Perceived Provider Performance – Reliability Attributes

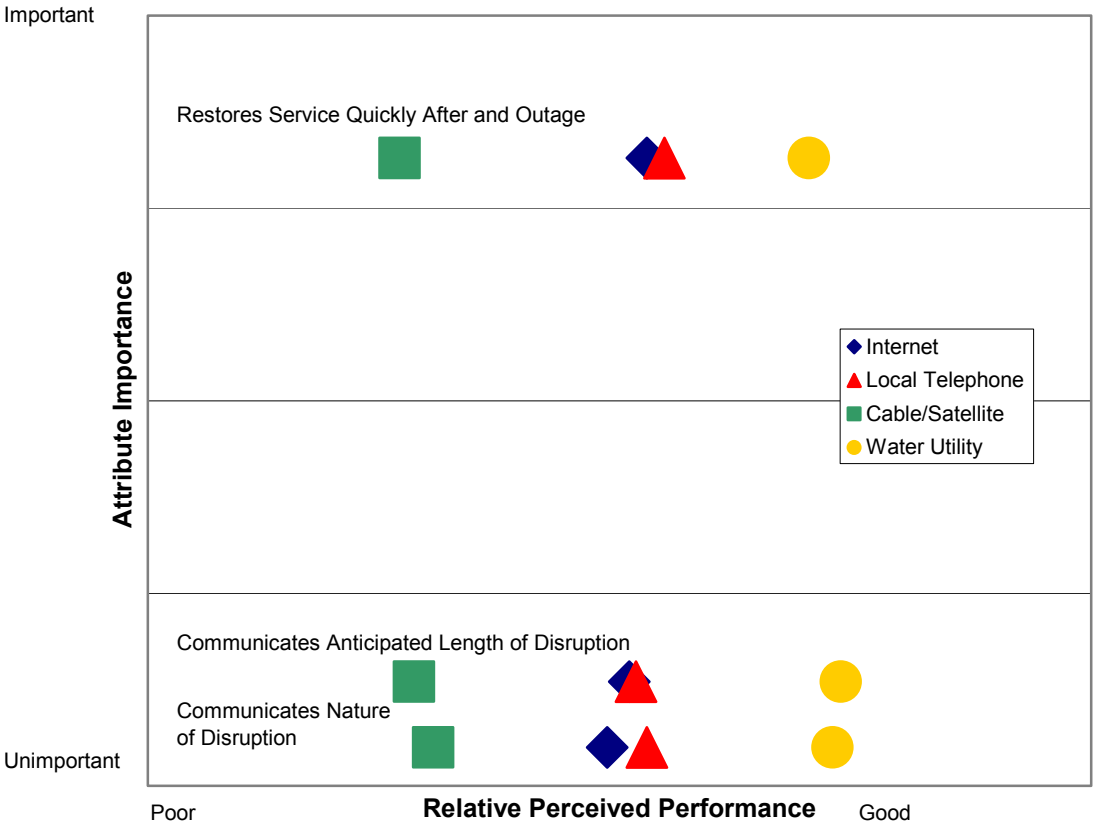


Figure 4.73: Actual Customer Satisfaction Drivers v. Perceived Provider Performance – Reliability Attributes

As seen in Figures 4.74 and 4.75, Bellevue and Kirkland business customers find maintaining stable rates and offering reasonable rates for basic service to be of highest importance using either weighting method. Maintaining stable rates was the second most important factor, and offering optional rate plans and reasonable rates for hook-up and installation were of negligible importance.

- Cable consistently scores worse than the other services.
- The water provider, local telephone provider and Internet providers were rated nearly the same but were rated far better than the cable provider.

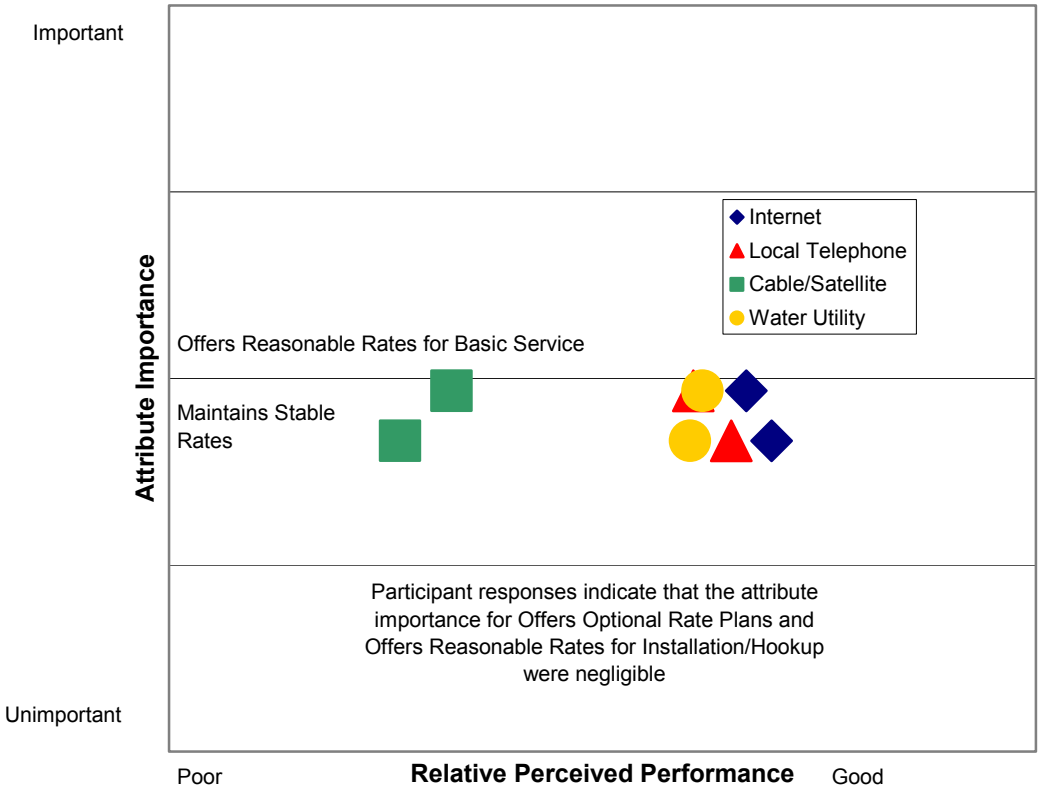


Figure 4.74: What Customers Say Is Important v. Perceived Provider Performance – Rates Attributes

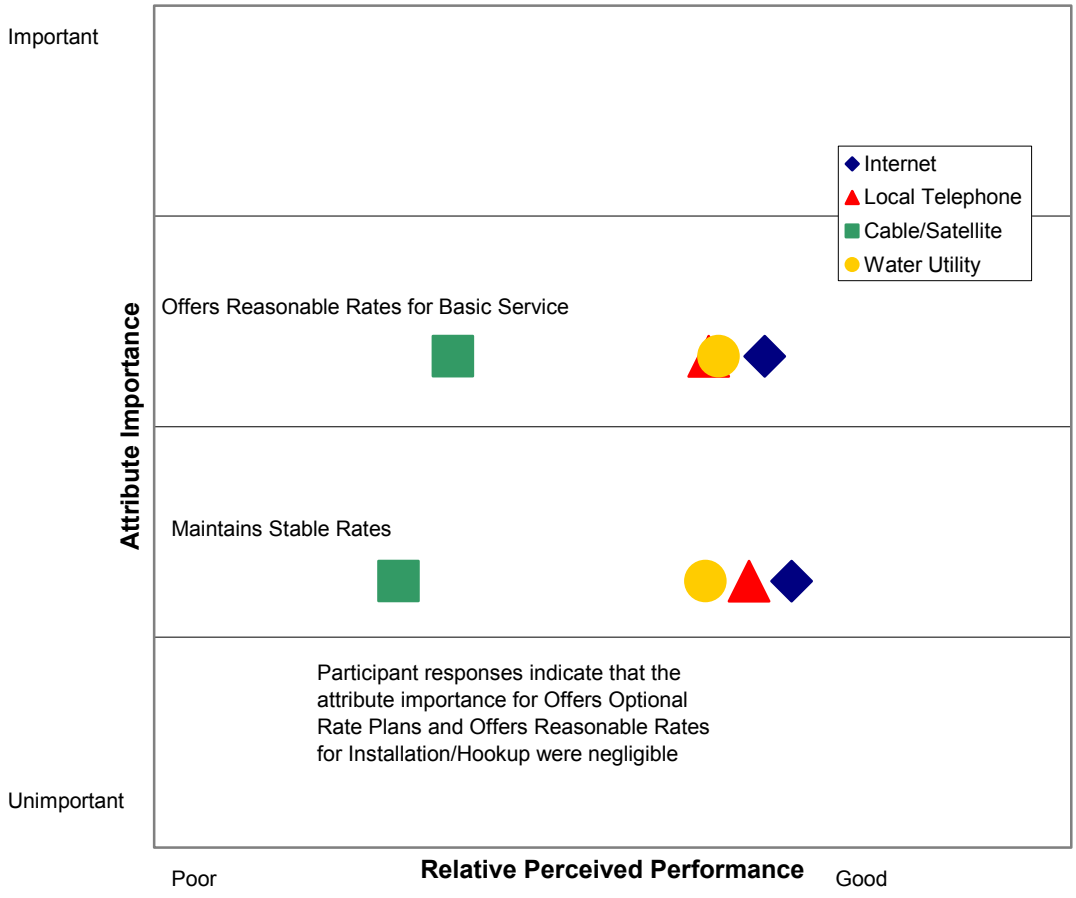


Figure 4.75: Actual Customer Satisfaction Drivers v. Perceived Provider Performance – Rates Attributes

Figures 4.76 and 4.77 show that, based on what customers say is important, Bellevue and Kirkland businesses find that doing the job right the first time is the most important customer service attribute. This was followed in importance by treating customers right and accurate billing.

As Figure 4.77 illustrates, offering alternative payment options is the most important driver of customer service using the "actual customer satisfaction" method. This was followed by doing the job right the first time.

- The water utility outperforms similar service providers in doing the job right the first time and treating customers as if they are valued.
- Internet providers performed best on offering alternative payment options, which was the most important attribute based on the "actual customer satisfaction drivers" method. It should be noted, however, that all of the service providers were tightly bunched in performance on this customer service sub-attribute.
- Cable providers, again, score consistently lower.

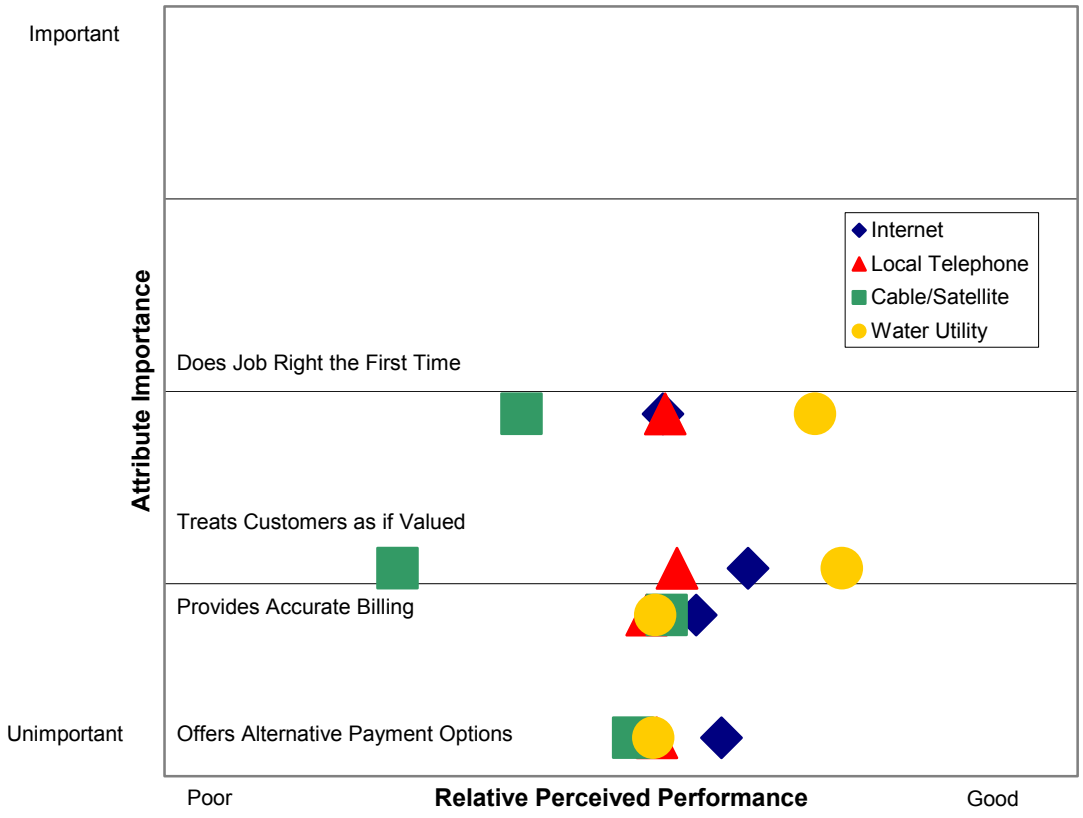


Figure 4.76: What Customers Say Is Important v. Perceived Provider Performance – Customer Service Attributes

Figure 4.77: Actual Customer Satisfaction Drivers v. Perceived Provider Performance – Customer Service Attributes

As seen in Figure 4.78, the "what customers say is important" weighting method shows that offering programs for low-income customers and active community involvement are the most important attributes of community service.

In Figure 4.79, the "actual customer satisfaction drivers" method indicates that active community involvement is most important and that the other community service attributes are of modest importance.

- The Internet providers outperform, by a wide margin, similar service providers in Bellevue and Kirkland in the active community involvement sub-attribute. Yet the Internet providers score lowest on offering programs to help low-income customers. The perceived active community involvement has a significant impact on the shift between the two methods of the value of the water utility offering.

- The water utility performs best on the local contact and presence sub-attribute.

- With the exception of offering programs to help low-income customers, cable providers score below the other providers.

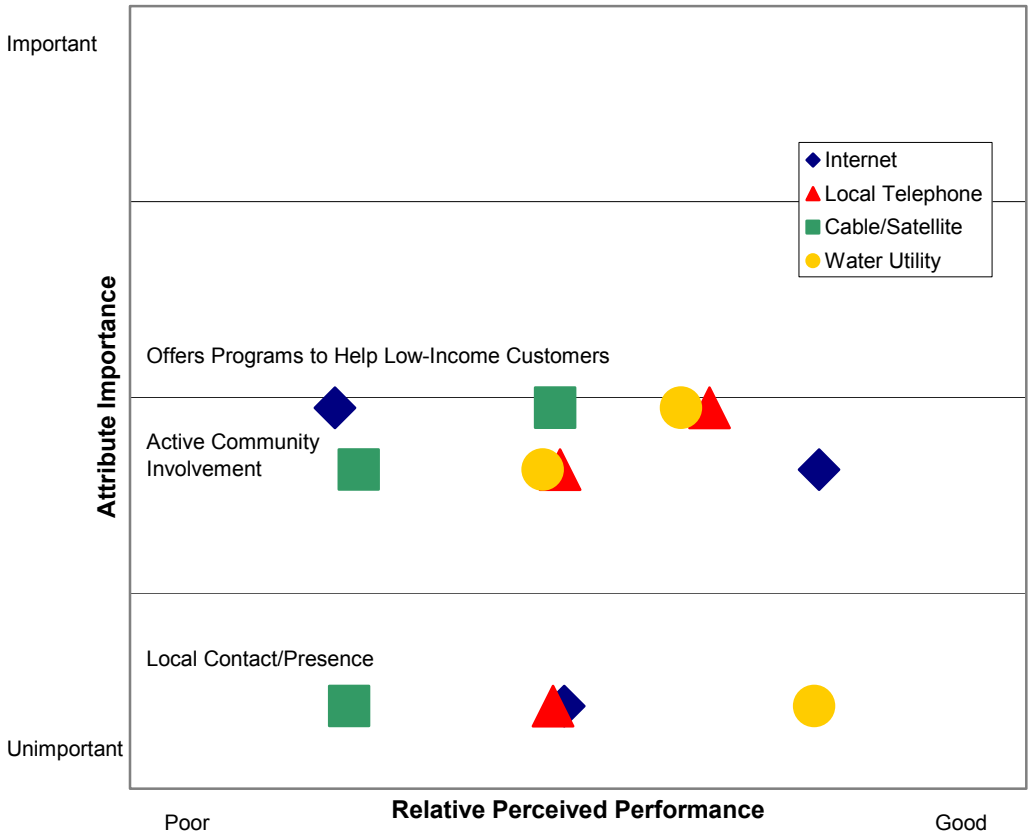


Figure 4.78: What Customers Say Is Important v. Perceived Provider Performance – Community Service Attributes

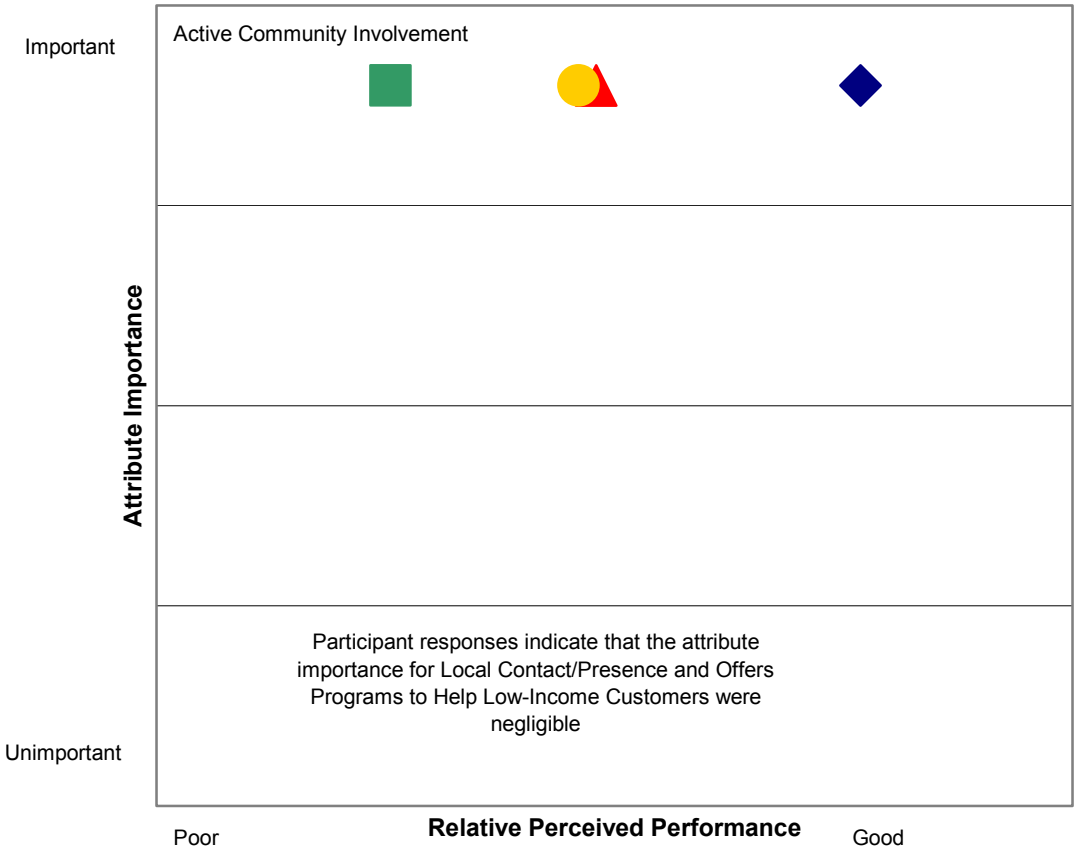


Figure 4.79: Actual Customer Satisfaction Drivers v. Perceived Provider Performance – Community Service Attributes

4.5 Retail Service Considerations

This section provides an analysis of the residential monthly expenditures for cable television, Internet, and telephone services. Understanding expenditure data is important when a business is considering offering retail services or exploring ways to facilitate new offerings. Of particular note, with the exception of one category, Bellevue and Kirkland residents pay more for telephone or cable television services than they pay for Internet access.

Bellevue and Kirkland residents have many choices among cable or satellite television, local telephone and Internet packages. This results in a wide distribution of preferences and, therefore, prices paid for connectivity services. Figure 4.80 depicts the distribution of total price paid per month for cable and satellite television, local telephone and Internet services in Bellevue and Kirkland. This figure shows how many residents of Bellevue and Kirkland pay within each $10 range between $25 and $225.[34]

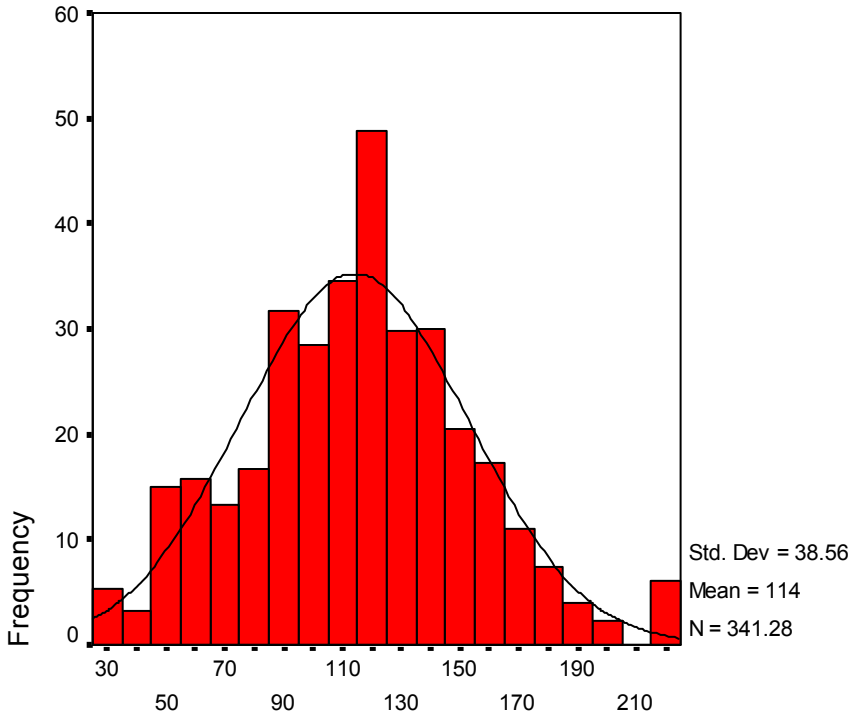


Figure 4.80: Total Price Paid Per Month for Connectivity Services

[34] Based on residential telephone surveys. Please see Section 3 for additional details.

The key point of Figure 4.80 is that residents have diverse preferences for the level of connectivity services they purchase each month. Figures 4.81 and 4.82 show how residents spend additional dollars on connectivity services as they progress from the bottom quartile (less than $88 per month) to the highest quartile (over $138 per month).

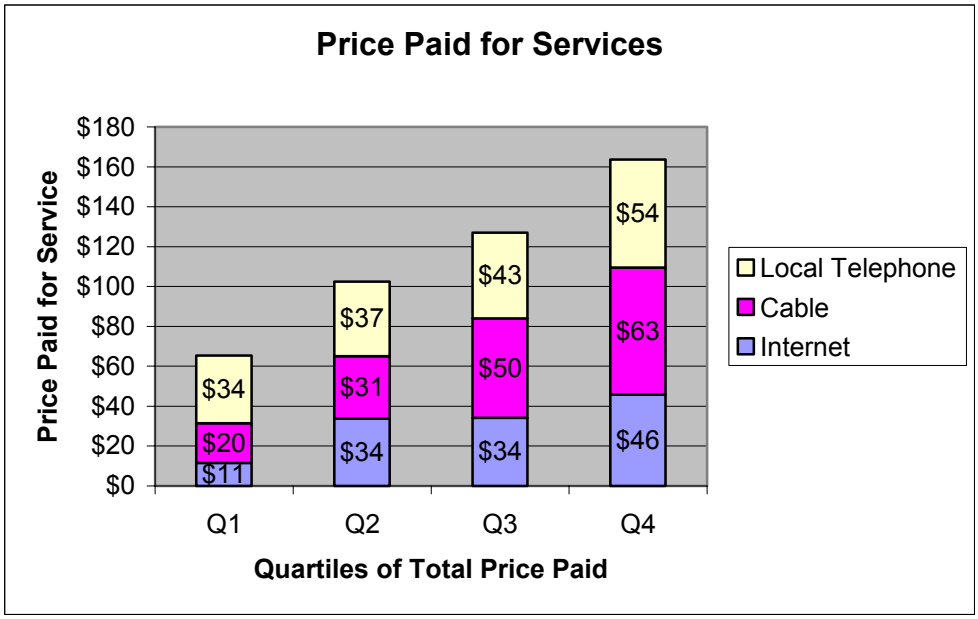


Figure 4.81: Price Paid for Each Connectivity Service (by Quartile)

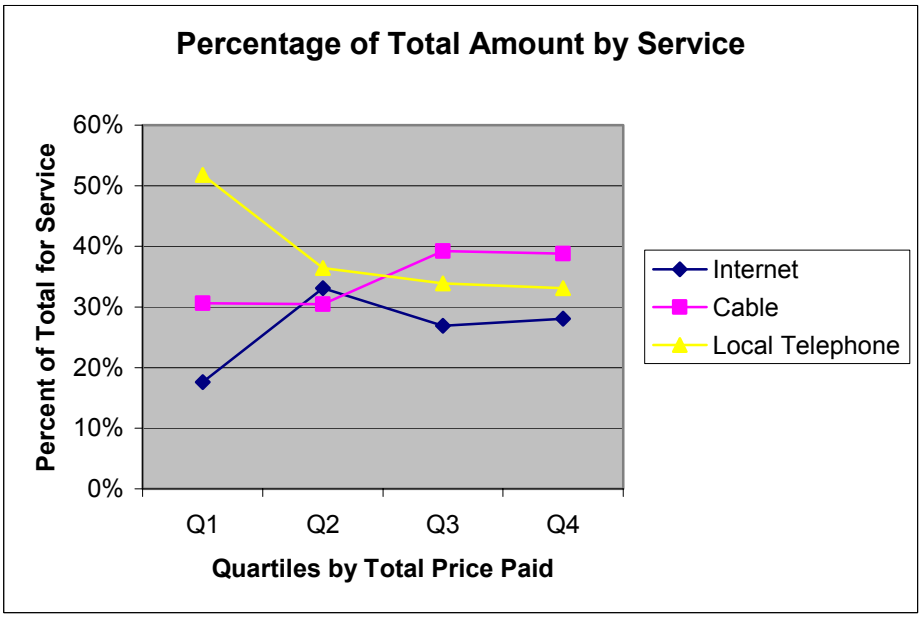


Figure 4.82: Percentage of Monthly Total Paid for Each Connectivity Service (by Quartile)

Figures 4.81 and 4.82 show that each quartile spends an increasing amount each month on connectivity services. However, the ways they spend their connectivity dollars does not stay constant as they increase the total amount spent.

The bottom quartile spends over 50 percent of their total monthly connectivity expenditures on local telephone service. Residents in the second quartile spend nearly the same amount on each service (with Internet seeing the largest increase from the first quartile).

Increases in cable spending between the 2nd and 3rd quartiles show that cable becomes the service with the highest average monthly cost for residents spending above the median amount on connectivity services. The relative position of the services stays constant between the 3rd and 4th quartiles, with cable retaining the largest share of the overall monthly connectivity expenditures.

Additional details on how residents and businesses use connectivity services, satisfaction with services, and willingness to switch providers are included in Exhibit I. This analysis will be leveraged in the business model development.

5. Regulatory Assessment

5.1 Overview

The providers and their respective infrastructures have a variety of regulations from local, state, and federal agencies. The regulations, at times, are conflicting and restrictive to the Bellevue and Kirkland initiative objectives.

- The FCC does not regulate the Internet or Internet Service Providers.
- The FCC regulates Radio Frequency (RF) emissions that might impact wireless Internet providers and cable television providers.
- The State of Washington and the FCC regulate voice telephone and carrier services heavily.

FCC Unbundling Ruling

In February 2003, the FCC adopted rules concerning the obligations of Incumbent Local Exchange Carriers (ILECs) to make elements of their networks available on an unbundled basis to non-facility-based connectivity[35] resellers. **The new rules are intended to provide incentives** for carriers (incumbents and new entrants) to invest in broadband network facilities, which will provide competitive alternatives.

The actual outcome of the rule may have the opposite effect. The demand for high-speed services may not be sufficient for a new entrant to build a separate infrastructure, thus leaving the ILEC and the cable television providers in control of the high-speed and broadband infrastructure. The question is, would continuing the federal line-sharing structure promote competition, create more choices for services, and motivate Regional Bell Operating Companies to continue broadband build-out?

Our concern is that ordered elimination of broadband line-sharing rules will leave incumbent carriers in charge of the infrastructure and the retail DSL service. Such elimination may reduce competition and lead to higher prices for high-speed Internet access. Today, some 40 percent of DSL service rides on circuits leased from RBOCs.

The FCC has also ordered that future broadband deployments with newer technologies such as fiber optics remain largely unregulated. This could undermine competition in an immature market and could result in monopolization of local broadband. The board has said repeatedly that first-mile loops create a bottleneck for broadband. Regulation that guarantees multiple first-mile carriers may help alleviate that bottleneck.

[35] The rule still requires unbundling of elements for voice telephone and carrier services.

In addition, rates paid to RBOCs by competitive carriers serving high-capacity voice loops for business users will now be set by individual states, leaving much uncertainty in an important area. The Supreme Court ordered the FCC to find a way to support the fundamental competitive tenets of the Telecommunications Act of 1996 with a ruling on unbundling these lines; instead, the FCC has opted not to decide but to shift the burden.

The commission can still change course, but if it does not, the courts must order the commission to make good on its responsibility to consumers whose access to competitive high-speed services has such an important role to play in the future of our economy.

Cellular Number Portability

The FCC has ordered local number portability (LNP) for wireline to wireless service. The order issued on November 10, 2003 gave wireline carriers operating in the 100 largest Metropolitan Stationed Areas (MSA) until November 24, 2003 to comply with the rules. Operators in the remaining markets need to comply by May 24, 2004. It is expected that this ruling will accelerate the movement of households using wireless service as their primary number.

The Legal Authority of Municipalities to Provide Communications Services

Federal law contemplates but does not affirmatively grant authority for municipal provision of communications services.

A municipality that is considering providing telecommunications services theoretically has a number of options ranging from doing nothing to becoming a full-service telecommunications services provider. Prior to making any decisions, the municipality must first carefully analyze a variety of considerations affecting its community, including legal, technical, marketing, financial, and political.

5.2 Federal Legislation (Voice, Video, Data)

Section 253 of the 1996 Telecommunications Act, entitled “Removal of Barriers to Entry,” prohibits any state or local legal requirement that would “prohibit or have the effect of prohibiting the ability of any entity to provide any interstate or intrastate telecommunications service.” Section 253(a) therefore stands as a general rule against establishing barriers to entry.

Subsections (b) and (c) of section 253, however, create “safe harbors” for certain types of state and local requirements. Even if a rule would “prohibit or have the effect of prohibiting” under subsection (a), it will not be preempted if it falls within the scope of (b) or (c). Finally, subsection (d) grants the Federal Communications Commission (FCC) review and preemption authority over subsections (a) and (b), but not with respect to subsection (c).

The full text of section 253 is as follows:

> § 253 REMOVAL OF BARRIERS TO ENTRY.
>
> (a) IN GENERAL. No State or local statute or regulation, or other State or local legal requirement, may prohibit or have the effect of prohibiting the ability of any entity to provide any interstate or intrastate telecommunications service.
>
> (b) STATE REGULATORY AUTHORITY. Nothing in this section shall affect the ability of a State to impose, on a competitively neutral basis and consistent with section 254, requirements necessary to preserve and advance universal service, protect the public safety and welfare, ensure the continued quality of telecommunications services, and safeguard the rights of consumers.
>
> (c) STATE AND LOCAL GOVERNMENT AUTHORITY. Nothing in this section affects the authority of a State or local government to manage the public rights-of-way or to require fair and reasonable compensation from telecommunications providers, on a competitively neutral and nondiscriminatory basis, for use of public rights-of-way on a nondiscriminatory basis, if the compensation required is publicly disclosed by such government.
>
> (d) PREEMPTION. If, after notice and an opportunity for public comment, the Commission determines that a State or local government has permitted or imposed any statute, regulation, or legal requirement that violates subsection (a) or (b), the Commission shall preempt the enforcement of such statute, regulation, or legal requirement to the extent necessary to correct such violation or inconsistency.

The section presumes that all telecommunications can be competitive, and thus, subsection (a) generally preempts state and local regulations that prohibit, or have the effect of prohibiting, the offering of a telecommunications service.

As discussed above, the provision contains “safe harbors” for certain types of state and local requirements. The first safe harbor, in subsection (b), preserves state regulatory authority to impose requirements regarding universal service, public safety and welfare, and consumer protection, as long as they are competitively neutral and consistent with section 254 (relating to universal service). The second safe harbor, in subsection (c), protects the ability of state and local governments to manage the public rights-of-way and to obtain compensation for the use thereof.

5.3 State (Voice, Video, Data, Dark Fiber, ROW)

State Law

Some states have expressly granted local governments broad authority to provide communications services. *See, e.g.,* Ala. Code § 11-50B-3; Ariz. Rev. Stat. § 9-511(A), 9-514(A) (with voter approval); California Const., Article XI, Section 9(a) and Cal. Pub. Utilities Code § 10001; 54 Cal. Atty. Gen. Ops. 135 (1971) and Fla. Stat. Ch. XII, § 166.047; O.C.G.A. §§ 46-5-163(b) and 46-5-163(17) (Georgia);5 Oregon Revised Statutes § 759.020; Va. Code § 15.2-2160 (competitive local exchange services) and § 56-484.7:1 ("qualifying communications services").

Some states have enacted outright prohibitions on municipal telecommunications activities. Examples include:

a. Texas bars municipalities and municipal electric utilities from offering telecommunications services or facilities directly or indirectly through private telecommunications providers. Texas Pub. Util. Code § 54.202 *et seq*.

b. Arkansas prohibits municipalities from providing local exchange services. Ark. Code § 23-17-409.

c. With certain limited exceptions, Nevada precludes cities with populations of 25,000 or more from offering any telecommunications services, as defined in the federal Telecommunications Act. Nevada Statutes § 268.086.

Some states have enacted measures that are not explicit prohibitions but that impose burdens that are difficult, if not impossible, to meet. For example:

i. Minnesota requires municipalities to obtain a 65% super-majority vote in order to provide telecommunications services. Minn. Stat. Ann. § 237.19.

ii. Massachusetts expressly authorizes cities and towns to provide communications services but impose onerous voting requirements. M.G.L., Ch. 164, Sections 34, 35 and 36.

Some states authorize local governments to provide some services but not others. Examples of partial barriers include:

i. Tennessee bans municipal provision of paging and security service but allows provision of cable, two-way video, video programming, Internet and other "like" services only upon satisfying various anti-competitive public disclosure, hearing and voting requirements that a private provider would not have to meet. Tenn. Code Ann. § 7-52-601 *et seq*.

ii. Nebraska prohibits public entities from becoming telecommunications carriers but allows them to offer "dark fiber" – fiber optic cable without the electronics required for transmission of information – under onerous conditions.6 Neb. Rev. Stat. § 86-2304 *et seq*.

iii. Arkansas prohibits municipal entities from providing basic local exchange services, but not other telecommunications services. Ark. Code § 23-17-409

Washington State Law

Washington falls within the fourth category of states. Its state code expressly authorizes Public Utility Districts to provide wholesale telecommunications services but does not furnish similar explicit authority to provide retail services. RCW § 54.16.330. More specifically, the code states that: "Nothing in this subsection shall be construed to authorize public utility districts to provide telecommunications services to end users."

If state law authorizes or permits public communications projects, the community must be sure to comply with or challenge relevant procedural requirements.

Does *"any entity"* include units of state government?

The FCC has not exercised its preemption authority in the case of statutory schemes prohibiting municipal provision of telecommunications services.[36] The Commission has twice considered the issue and twice ruled against preemption.[37]

In response to the Texas Public Utility Commission's request for a ruling that the Texas Public Utility Regulatory Act of 1995's ("PURA") prohibition on municipal entry violated the 1996 Act, the Commission held that municipalities are creatures of the state and the state (through legislation) had authority to keep them out of the telecommunications market. *Public Utility Commission of Texas*, 13 FCC Rcd 3460 (1997).

The Commission held that the prohibition "is an exercise of the Texas legislature's power to define the contours of the authority delegated to the state's political subdivisions," and that the Supreme Court's decision in *Gregory v. Ashcroft*, 501 U.S. 452 (1991), held that such "fundamental state decisions" remain within the State's authority "absent a clear indication of intent." 13 FCC Rcd at 3545-3546. The Commission distinguished "the question of whether federal standards may be applied to an arm of a Texas municipality," from the question whether the State may "define the scope of the authority delegated to a state's own political subdivisions," which is subject to the Gregory rule. *Id* at 3546. The former is not subject to the Gregory rule while the latter is.

[36] While the Commission has not acted to preempt state barriers to entry, it has noted that "[m]unicipal entry can bring significant benefits by making additional facilities available for the provision of competitive services" and has "encourage[d] states to avoid enacting absolute prohibitions on municipal entry into telecommunications." *Public Utility Commission of Texas*, 13 FCC Rcd 3460, 3549 (1997).

[37] The Federal Communications Commission employs a two step process in its evaluation of statutes under § 253. It first determines whether the statue violates the section. Upon a finding that it does, the Commission will then consider whether the prohibition falls within the safe harbor of § 253(b).

Applying *Gregory* to Section 253(a), the Commission was unable to find that the use of the term "any entity" in Section 253(a) constituted a sufficiently clear statement that Congress specifically intended to include municipalities within the scope of Section 253(a) preemption and thereby intrude into the scope of authority that a State may delegate to its own political subdivisions. *Id* at 3546-3549.

The D.C. Circuit affirmed the Commission in *City of Abilene v. FCC*, 164 F.3d 49 (D.C. Cir. 1999). The court agreed with the Commission that "§ 253(a) must be construed in compliance with the precepts laid down in *Gregory v. Ashcroft*, "because "interfering with the relationship between a State and its political subdivisions strikes near the heart of State sovereignty." *Id* at 52. The court further held that it must "be certain that Congress intended § 253(a) to govern State-local relationships regarding the provision of telecommunications services" before Section 253(a) may be applied to do so. *Id*. The D.C. Circuit concluded that "it was not plain to the Commission, and it is not plain to us, that § 253(a) was meant to include municipalities in the category 'any entity.'" *Id* at 54.

In *Missouri Municipal League*, the Commission again held that the term “any entity” in Section 253(a) does *not* apply to public entities. 16 FCC Rcd 1157 (2001). Unlike the D.C. Circuit, however, the Eighth Circuit reversed. *Municipal League v. FCC*, 299 F.3d 1949 (8th Cir. 2002). The Eighth Circuit concluded that the plain meaning of the phrase “any entity” meant that municipalities were encompassed within the protections afforded by the statute, i.e., that Congress had intended to include municipalities within § 253(a).[38]

Recently, however, the Supreme Court reversed the Eighth Circuit’s decision,[39] essentially validating both the Commission’s decision in this case and the D.C. Circuit’s decision in *City of Abilene v. FCC*. The question presented was:

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[38] Two state courts have relied on the FCC’s interpretation of Section 253(a) as set forth in the *Texas* and *Missouri* decisions. *Municipal Elec. Auth. of Georgia v. Ga. Pub. Serv. Comm’n*, 241 Ga.App. 237, 525 S.E.2d 399, 403 (1999), *cert. denied*, *Municipal Electric Authority of Georgia v. Georgia Public Service Comm’n* (Ga. 2000); *Iowa Tel. Ass’n v. City of Hawarden, IA*, 589 N.W.2d 245, 252 (Iowa 1999).

On the contrary, a federal district court in the Western District of Virginia held that the use of the broad language “any entity” made it “clear and manifest that Congress intended section 253(a) to have sweeping application, including areas in which states traditionally enjoyed exclusive regulatory power.” *City of Bristol v. Earley,* 145 F. Supp. 2d (W.D. Va. 2000). Accordingly, the court held that a Virginia statute prohibiting municipalities from providing telecommunications services to the public was preempted by section 253(a). See also: In re Lincoln Electric System, 655 N.W.2d 363 (Neb. 2003) (holding that Section 253(a) preempts state authority).

Insofar as telecommunications services are concerned, Section 253(a) of the Telecommunications Act applies to the provision of “any interstate or intrastate telecommunications service.” Thus, partial barriers are arguably invalid under the rationale of the Eighth Circuit’s decision in the *Missouri* case and the federal district court’s decision in the *Bristol* case.

[39] *Nixon v. Missouri Municipal League*, 124 S. Ct. 1555; 158 L. Ed. 2d 291 (2004).

> Whether 47 U.S.C. § 253(a), which provides that "[n]o State *** regulation *** may prohibit *** the ability of any entity to provide any interstate or intrastate telecommunications service," preempts a state law prohibiting political subdivisions of the State from offering telecommunications service to the public.

The court was tasked with clarifying whether "any entity" includes municipalities and municipal-owned utilities. As to that question, the Court found that Congress used the term "any entity" only "with a limited reference to any private entity when it cast the preemption net."

The Court also addressed the public policy argument that allowing municipalities to furnish telecommunications services will offer competitive advantages and that "fencing governmental entities out of the telecommunications business flouts the public interest." The court failed to find a nexus:

> it does not follow that preempting state or local barriers to governmental entry into the market would be an effective way to draw municipalities into the business and in any event the issue here does not turn on the merits of municipal telecommunications services.

Therefore, unless and until the statutory provision is amended to make clear Congress' intent to preempt so as to free public entities from state or local limitations on the provision of telecommunications services, such entities with be subject the power of the legislature in the field.

Wholesale Telecommunications Services by P.U.D.S.

SENATE BILL 6598, entitled "Wholesale Telecommunications Services by P.U.D.S", amending 3 RCW 54.16.330, was recently enacted and signed into law. The legislation authorizes public utility districts in existence on June 8, 2000, to construct, purchase, acquire, develop, finance, lease, license, handle, provide, add to, contract for, interconnect, alter, improve, repair, operate, and maintain any telecommunications facilities within or without the district's limits for the following purposes: (a) For the district's internal telecommunications needs; and (b) For the provision of wholesale telecommunications services within the district and by contract with another public utility district.

The legislation provides that it is not to be construed to authorize the provision of telecommunications services to end users. This provision is likely lawful given the *Nixon v. Missouri Municipal League* decision.

The provision of the aforementioned services is subject to the requirement that rates, terms and conditions not be unduly or unreasonably discriminatory or preferential. The failure to offer substantially similar rates terms and conditions for substantially similar services will be considered to be discriminatory or preferential. Revenues from the provision of services are to be dedicated to the costs incurred to build and maintain the facilities constructed or acquired for the provision of service until any financing instruments executed after June 8, 2000 and used to finance the facilities are retired. Additionally, when a utility district provides wholesale services, all services rendered to the district for its internal communications must be allocated or charged at full value.

6. Industry Trends

6.1 Economic Development

In the main report, we discussed the relationship of connectivity and economic development. In the discussions, core and secondary strategies were introduced. This section provides a more detailed review of the secondary strategies.

Targeting Industries

In order to continue to compete successfully in the global economy, Bellevue and Kirkland must embrace specialization. **We recommend local policymakers take stock of the region's current strengths and identify the region's comparative advantages in production (whether of goods, services or knowledge).** The region can then build on its comparative advantages and catalyze economic growth through regional clusters of specialization. Clusters of specialization can be public–private partnerships that include producers who function in competition and cooperation with each other, producers and suppliers of complimentary goods and services, and research institutions that serve as the vanguard of process innovation for the local economy. Internationally, policymakers are recognizing that industry clusters foster collaboration and innovation for new and traditional industries alike. They provide countless networking opportunities between competing and cooperating producers, suppliers, distributors, and research and development experts, allowing firms and community or regional clusters to respond in a timely manner to market signals in the rapidly changing global economy. Successful industry clusters have the potential to function as incubators of innovation, particularly when aligned with an effective strategy for workforce training. Bellevue and Kirkland are both affluent communities with significant existing public communications assets; as such, they have a relative advantage over many communities and are well positioned for innovation. Both communities are, and should continue to be, proactive in advancing communications capacity in order to meet the infrastructure demands of increasing and evolving applications.

Training

In addition to connectivity and industry cluster strategies, policies that promote investment in human capital (or, more generally, *training*) are increasingly important for the economic development needed to keep the region globally competitive. Economically successful regions have become, or are in the process of becoming, knowledge economies.[40] The defining characteristic of these knowledge economies is the rising relative value of human capital, while lifelong learning is acknowledged as the means for enhancing human capital.

Unlike previous eras, in which the skills and credentials required for job activities were relatively static, **competencies for job activities in today's knowledge economy are in a state of perpetual change.** More than ever, new technologies and emerging trends necessitate among workers an aptitude for change and an ability to combine a variety of talents in unprecedented ways.

[40] Knowledge economies are those in which knowledge and skills are major factors of productivity.

Proactive development of training programs is imperative. Training programs must be components of a region's workforce development strategy—not simply a service provided to unemployed or disadvantaged workers. Policymakers can partner with private sector employers to invest in skill augmentation of the incumbent workforce, as well as coordinate education and economic development policies to reflect the value of lifelong learning and lifelong skill enhancement that will complement the business plans of local private sector entities. Furthermore, alignment of workforce development strategies with the local economy's current and future workforce needs is critical. Equally critical is the need for local policymakers to consider trends in the global economy in any assessment of workforce needs. Policymakers, in partnership with private sector employers, must align training programs for disadvantaged workers and the unemployed with the needs of the new economy in a manner that does not create additional low skill and low pay jobs; rather, the goal of such partnerships should be to further develop human capital and create high skill and high pay employment. Worth stressing: This training strategy is not limited in application to those who provide relatively low skill services. As the nation witnesses an increased international outflow of professional jobs, training and innovation for the employed, high-skilled, and highly educated sector of the workforce is also warranted.

Taken together, the objective of the economic development strategies described above—developing a robust telecommunications infrastructure, targeting industries and developing industry clusters, and aligning local training efforts with economic development goals—is to create a comprehensive catalyst for economic development that will expand both job opportunities and business opportunities. Fundamental to this objective is the ability to match skills to the needs of the marketplace, which will be achieved in part by training low- and moderate-income workers as well as professionals. Achieving this objective will yield two benefits: (1) workers with skills that are in high demand will be available to match employers' needs, and (2) the workforce will continue to achieve economic stability and self-sufficiency.

Quantifying the economic benefits of the deployment of broadband is quite difficult because the technology is newly emerging and other factors of economic development cannot be held constant. Economists, however, have begun to study and quantify the impacts, in dollars, of broadband deployment and the applications it can and will enable. Crandall and Jackson, for example, estimate that the total annual benefit to the U.S. economy of widespread adoption of broadband access is more than $400 billion each year.[41] They derive this estimate from complex calculations that include a variety of variables from increased broadband subscription revenue to reduced travel time and costs for retail and wholesale shopping and steelwork.

Applications

Broadband can be used for many applications, and we estimate that the potential economic and social benefits of an advanced and robust connectivity infrastructure will be significant. The long-term benefits of applications that enable broadband—for government, commerce, education, research and medicine—include the region's ability to retain, expand and attract businesses and investments as well as continued workforce excellence.

[41] Robert W. Crandall and Charles L. Jackson. The $500 Billion Opportunity: The Potential Economic Benefit of Widespread Diffusion of Broadband Internet Access. (Criterion Economics, L.L.C., July 2001, page 2.)

Some of these applications are described briefly below.

- **Public Safety:** Reliable broadband connectivity can enhance the delivery of public services, such as public safety. Our nation has given considerable attention to the value of connectivity for public safety purposes since the terrorist attack of September 11, 2001. Leveraging advanced communications networks can provide significant opportunities to enhance public safety—not only through the communities' first responders but also through virtual neighborhood applications that would be facilitated by high-speed communications.

  Some of these public safety applications are described briefly below.

  - **Biometrics:** Biometrics, or methods of personal identification based on physiological or behavioral characteristics, can be used in lieu of passwords and other traditional forms of identification (e.g., passports and driver's licenses) to grant access to electronic devices such as personal computers, cellular phones, and personal digital assistants, networks, financial and other personal records, buildings, and even political jurisdictions (e.g., international borders). Biometrics offer useful forensic tools that use fingerprint matching, iris and retinal scans, facial recognition, recognition of speech patterns, recognition of hand geometry, or a combination of these measures to either identify or authenticate identification of an individual who is seeking access to a device, a location, or information.

  - **Surveillance:** Broadband connectivity can enhance remote surveillance capability of public safety officials at airports and borders, as well as other transportation hubs such as ports, train stations and bus depots. Additionally, surveillance technologies have advanced remarkably in recent years to allow surveillance of medical symptoms that would indicate illness of epidemic proportion and acts of bioterror.

  - **Telework or Telecommuting:** Telework (discussed in more detail below) is another public safety application enabled by broadband connectivity. It enables public safety and other public officials to perform normal and disaster recovery functions—especially emergency communications—from remote sites in the event of an outage or catastrophe that makes normal workplaces inaccessible or inoperable. The security benefits of teleworking capacity in the event of catastrophe are not limited to public officials; the ability to continue relatively normal business and social functions in a disrupted environment can help maintain organizational and more general economic security within the private sector as well. Local and national government agencies realized the benefits of telework and electronic data exchange during recent anthrax threats.

  - **Law Enforcement Communication and Investigation:** Broadband networks can also improve and expedite the work of fire, rescue, and law enforcement officials who spend a significant amount of their working hours in remote locations (i.e., not at the fire station or precinct). These officials need to be able to transfer and access large data and image files while in the field in order to share criminal, GIS, and other information in real time. Moreover, in an environment of terrorist threats, broadband networks can help meet the need for effective cross-agency coordination and information exchange.

Preparedness and training are critical to the effectiveness of fire and law enforcement officials. These officials, as well as taxpayers and public managers, can benefit from training exercises through video conferencing, which minimizes travel and facility needs, allowing more trainees to benefit from fewer instructors at a reduced cost.

- **E-Commerce:** Broadband connectivity provides an alternative means for the sale of products and services through e-commerce. E-commerce gives consumers a larger variety of products and services from which to choose and offers increased choice with greater efficiency because the model reduces transaction costs. With respect to retail and wholesale efficiencies enabled by broadband, Crandall and Jackson estimate that as broadband access becomes ubiquitous across households, efficiency will increase by 20 percent and result in a consumer gain of $480 billion annually.[42] E-commerce can also achieve producer gains by providing access to a new customer base. For example, a small retail shop based in Rochelle, Illinois that specializes in hobby trains and equipment greatly expanded its business when it closed its retail storefront and began selling its goods over the Internet. The store no longer relies solely on traffic passing down Main Street and is now able to offer its goods to a wider online customer base.

- **E-Government, or Delivery of Government Services Online:** E-government refers to government use of connectivity to perform its daily informational and transactional functions. Governments, like private sector entities, have responded to citizen demands for online information and services by developing Web portals that serve as comprehensive guides to government. This innovation helps minimize the time and effort citizens expend on transactions with their governments and offers unprecedented flexibility for interacting with government. The trend is internationally recognized as a means to enhance economic and social development, with significant potential for administrative savings through lower transaction costs in the long run.[43] Government agencies can reduce time and materials costs because the need for citizens to access government buildings, public officials, printed forms and other documents in person decreases. Additionally, online interaction with government (e.g., online voting) can increase citizen participation and enhance the ability of citizens to operate in an information economy and augment social capital. When government agencies standardize, they benefit from lower costs, less redundancy, and an ability to share and integrate information.

[42] Robert W. Crandall and Charles L. Jackson. The $500 Billion Opportunity: The Potential Economic Benefit of Widespread Diffusion of Broadband Internet Access. (Criterion Economics, L.L.C., July 2001, page 32.)

[43] The potential for administrative savings is limited by connectivity penetration and the digital divide; i.e., all citizens would need connectivity access that supports the applications of e-government before the traditional model of providing government services (i.e., in government buildings with the assistance of government employees) is abandoned.

- **Telework:** Telework, also known as telecommuting, refers to the practice of moving work closer to workers as an alternative to the traditional model of moving workers to their work. Advancements in technology, particularly telecommunications technology, have made teleworking more feasible by removing the obstacles that have typically required the physical presence of workers in traditional workplaces. Telework can offer substantial efficiency benefits to both employers and employees by cutting costs, saving time, reducing stress, and decreasing congestion on roads and bridges. Additionally, telework is touted as a progressive and cooperative measure toward environmental protection. A study by the U.S. Office of Personnel Management concluded that most employees who participated in a telework pilot program believed their productivity increased and stress decreased as a result of telework.[44]

- **Tourism:** Tourism is the focus of economic development strategies in communities across the globe. To enhance traditional methods for attracting tourists, broadband networks can facilitate the efforts of local visitor bureaus and other tourism agents to generate tourism-related revenue. By making information available quickly and providing attractive marketing via images and virtual tours, tourism agents will have the opportunity to capture a larger tourist base than they are able to with traditional marketing methods. Real-time reservations and ticketing capabilities can enhance tourism applications. These benefits also accrue to communities that are addressing the negative ecological impacts of conventional models of tourism by fostering eco-tourism—an approach that emphasizes preservation of the ecosystem by educating tourists.

- **Distance Learning:** Broadband-enabled distance learning holds remarkable potential for developing human capital in a knowledge economy and provides countless opportunities for learners of all ages to take advantage of curricular offerings regardless of geographic location. Distance learning can serve as a means to higher education, continuing education, corporate training, and home schooling—all of which support the lifelong learning required by a knowledge economy. According to the National Center for Education Statistics (NCES), a distance learning initiative called the Star Program helps provide quality, cost-effective education to 1.6 million elementary and secondary level learners annually in the United States, the District of Columbia, and U.S. territories. NCES reports that the Star Program (1) focuses on student performance in mathematics, science, foreign languages and literacy, and vocational skills and (2) targets disadvantaged, illiterate, and limited-English populations as well as individuals with disabilities. NCES identified a distance learning trend within higher education, noting that in 1997–1998 one-third of two-year and four-year post-secondary institutions offered distance learning courses, with an additional 20 percent of post-secondary institutions planning to launch such courses within three years. In 1997–1998, post-secondary distance learning programs enrolled an estimated 1,661,100 students, with 1,363,670 of these in college-level courses for credit.[45]

[44] United States Office of Personnel Management, http://www.opm.gov/studies/FINAL-TELEWRK.htm.
[45] The National Center for Education Statistics, http://nces.ed.gov/fastfacts/display.asp?id=79.

- **Telemedicine:** Telemedicine refers to a broadband-enabled application for the delivery of medical care. It includes information exchange and diagnosis between medical professionals and patients when a personal visit would not otherwise be feasible (e.g., because the patient is too ill, the patient lives too far away from a medical center, medical specialists are scarce). Telemedicine also enables patients to study and purchase medical supplies (including pharmaceutical prescriptions) online. Telemedicine provides a forum for medical professionals and paraprofessionals to share information and resources in real time, theoretically enabling a global consult for patients' benefits. This application can greatly reduce the transaction costs of medical care (e.g., prohibitive transportation costs associated with medical care), thereby increasing healthcare consumption.

- **Entertainment:** High-speed and broadband connectivity services have the potential to transform the entertainment industry. Traditional "services" include broadcast and cable television, radio, and other non-interactive media. With broadband services, users have not only the ability to choose which venue to listen to or watch but also the opportunity to interact. Examples include:

  - Today, you can listen to any National Football League (NFL) game over the Internet. Broadband has the potential to deliver streaming video of a quality superior to broadcast television, eliminating the middle person and enabling content creators to deliver service directly to consumers.

  - Multi-gaming is a growing industry. No longer do you need to be in the same location to compete against other players. High-speed Internet services support multi-gaming today, and the advent of broadband will enable higher quality video and other enhanced services.

- **Video Conferencing:** Video conferencing technology is an efficient way to do business, enabling businesses and other organizations to reduce transaction costs (particularly by minimizing transportation costs) and realize the advantages of large-scale, real-time communication. Broadband-based video conferencing avoids the requirements of maintaining expensive ISDN lines and per-minute connection fees.

6.2 Best Practices

Best practices, when used as a management tool, can provide guidance, identifying within the discipline those processes and actions that will most likely result in success. Best practices can range from a set of engineering specifications to processes for developing an educational curriculum for elementary school students. Bellevue and Kirkland are faced with the continuing challenge of developing a process that will, over time, build upon connectivity efforts to date and incorporate new methods and ideas to further the quality of life in the community. To that end, we recommend the two cities incorporate three elements in their ongoing efforts:

1. **Sustainability Over Time.** Achieving broadband connectivity for all will take years to accomplish, so best practices must be sustainable over time.

2. **Continual Assessment.** The cities must continuously assess changes in population, technology and economic conditions to determine current best practices for achieving the overall objective.

3. **Flexibility.** As conditions change, best practices will also change. The process must therefore be flexible and opportunistic to take advantage of new opportunities that will advance the cities more quickly toward their goal of broadband connectivity for all.

Within this context and given these criteria, we recommend the following best practices for Bellevue and Kirkland.

Work From a Strategic Plan

A strategic plan can help an organization create a context for decision making, quantify objectives and define the terms necessary for success (e.g., ubiquitous connectivity, targeted successful collaborations, and improved economic development). It provides a set of objectives from which success or failure can be maintained and provides a marker against which changes in the environment can be measured. By defining goals across a significant period of time, a strategic plan can help an organization assess where it has been, its current state, and its objectives for the future.

A strategic plan should balance the desire for always-available connectivity and the need for adequate capacity to serve targeted and important user communities. This will require a strategic plan that identifies both local and regional concerns, an understanding of diverse connectivity requirements, and the ability to build upon existing connectivity efforts while taking advantage of new opportunities and justifications.

Understand and Update Economic Justifications

Over an extended period, economic models that currently shape the deployment of broadband connectivity will change. The most recent example of this rapidly changing deployment landscape is the current rulings on network access by both the Federal Communications Commission and the Federal Courts. Planning by both public and private entities will certainly be affected by the redefinition of those who have access to existing connectivity infrastructure and at what price. The decision to rely, in whole or in part, on public or private initiatives may well be a function of the city's ability to assess underlying economic justifications as they change over time. This process will require well-documented and updated facts to support the sustainability of proposed economic models and will allow the cities to more correctly assess risk connected to the adoption of any particular service or delivery model.

Understand and Evaluate the Migration Path Before Deploying a Broadband Technology

All telecommunications technology operates on the assumption that it will be replaced over time with new and more efficient technology. Some technologies are designed to fulfill a short-term requirement (12–60 months), while others are long-term in nature (15–20 years). If planners understand the life cycle of a technology, they will be able to determine whether the value inherent in the technology is consistent with the investment required. To illustrate this, our interviews have indicated that current "high-speed" connectivity services such as DSL and T-1 lines have, in a short period of time, become inadequate to support the mix of applications for the schools and hospitals in both Bellevue and Kirkland. New connectivity initiatives therefore must assume a baseline capability beyond that offered by DSL and T-1 facilities.

Proposed technologies must also be examined to determine whether they are vulnerable to new disruptive technologies (technologies that would replace the existing technology in a short period of time) or whether the technology possesses a clear migration path such that succeeding technologies can be implemented on the foundation of the initial deployment. Consider the deployment of the radio frequency (RF) network constructed by the Schlumberger Company for Puget Sound Energy (PSE). The network was developed primarily to read electric meters but was also able to accommodate new applications such as security and sensor monitoring, which might be deployed over time. The failure of organizations to consider these issues usually results in lost opportunities and expensive and disruptive replacement of the technological base.

Understand the Unique Needs of Each Segment of the Community

Need does not adapt to technological solutions; rather technology must always be the consequence of a defined need. Defining need requires a planned dialog with the community to determine which requirements are common to all populations, as well as which requirements are limited and specific in nature. For example, the requirements for broadband connectivity will differ substantially for a small real estate office versus a large manufacturing facility. To illustrate this point, during interviews we noted interest in wireless "hot-spot" technology for public spaces, suggesting a vibrant and interested community where work or lifestyle might require more ubiquitous broadband access. Unless cities correctly identify the unique requirements of their populations and the way these requirements are likely to change over time, they are in danger of applying generalized solutions that will not address the population's spectrum of needs.

Look for Opportunities to Meet Multiple Needs With A Common Solution Wherever Possible

Most technologies that deliver broadband services are flexible and can accommodate multiple uses within the same physical environment. Current packet technology that can transport video, voice and data as a series of discrete data streams within the same physical medium (wireless, fiber, coax) presents the opportunity to identify and connect multiple users to a common infrastructure to make more efficient use of a broadband connection. This opportunistic policy provides numerous benefits. Sharing resources reduces the costs of broadband deployment for each user. The efficient use of infrastructure serves greater populations at less cost and encourages decision makers and the public to look favorably on further investments in infrastructure and deployment.

Our interviews indicated substantial opportunities for aggregation in both Bellevue and Kirkland. Each of the K–12 school districts recognizes substantial benefit in connecting their schools over a fiber optic network. They are interested, as well, in pursuing interconnection between districts, secondary schools and community colleges. Interviewees also expressed the desire to connect to other public agencies, such as law enforcement facilities. Our experience indicates that aggregated community needs can be satisfied by a common infrastructure, the result being a more dynamic environment of connectivity and greater satisfaction among user communities.

6.3 Steps to Becoming a More Wired City

In developing a most-wired-city campaign, communities need to consider the following action items:

1. **Put More City Services Online and Promote Them**

   (Bellevue and Kirkland are well underway on this item.)

   Although many cities have an online presence, the quality of the content and usefulness of the sites varies greatly. Offering city services and the ability to perform transactions online can minimize citizens' frustration and the amount of time they must spend interacting with their government. Putting services online can also create significant cost savings for the city.

   Promotion of online services is a hallmark of wired cities. If people are not aware of such services, they will not use them. When citizens learn how to use the Internet to interact with their government, the result is a population that is more capable of navigating the information economy.

2. **Increase Awareness of the Benefits of the Internet**

   (The use of the Internet in Bellevue and Kirkland is well above the national average.)

   Two main themes pertain to education or knowledge. The first is a lack of knowledge of what information or services are available through the use of high-speed connectivity. For example, a resident or business may not know what they can do once they have access to a fast, reliable Internet connection. The second is a lack of knowledge of how to gain access to broadband services. Questions such as, who are the providers in my area? What type of personal computer (PC) do I need? What type of connection is best for me based on what I want to do? A knowledgeable user base of both individuals and organizations is a necessity for a wired city, and wired cities provide this information to help boost awareness of the benefits of the Internet among businesses and residents of the city.

3. **Provide Free Internet Access Sites and Wireless "Hot Spots"**

   (Libraries and other areas provide free access today. The wireless hot spot model expands the availability.)

   Wired cities deploy free Internet access sites and wireless hot spots to facilitate public access and economic development objectives. Locations may include commercial centers, government facilities, museums, community centers, libraries, schools, and other points of public gatherings.

4. **Develop Policy Positions and Make Them Public**

   (Privacy issues have been raised by Bellevue and Kirkland city councils. As applications continue to expand, policy issues will become critical.)

   Protecting privacy, limiting "spam" e-mails, promoting consumer protection, and creating an Internet access surcharge are all important policy areas for federal, state and local decision makers. Wired cities have developed well-formed policy positions on these and other policy areas and have engaged citizens to help them understand the implications of the outcomes of these policy debates.

5. **Consider Strategically Building Infrastructure**

   (Bellevue and Kirkland have done an excellent job in strategic deployment. The Network of Networks model expands the regional connectivity.)

   Many wired cities have considered or implemented the construction of connectivity infrastructure, often connecting municipal, educational, medical and other public facilities. In some cases, cities have left open the option of entering or have entered the market for connectivity services. When considering infrastructure improvements, cities should keep in mind economic development efforts, improvement of education facilities and access to education, and the city's connectivity needs.